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OF THE

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

1898

NUMBERS 49 TO 59

AND

TENTH ANNUAL REPORT.

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

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Bulletin 49 **January, 1898**

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

THE

INSPECTION OF FERTILIZERS

IN 1897

IN CO-OPERATION WITH THE STATE BOARD
OF AGRICULTURE

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM, N. H.

NEW HAMPSHIRE COLLEGE

OF

AGRICULTURE AND THE MECHANIC ARTS

AGRICULTURAL EXPERIMENT STATION

DURHAM, N. H.

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The Bulletins of this Station are sent free to any resident of New Hampshire upon application

THE FERTILIZER INSPECTION IN 1897

This year, as in the past, the New Hampshire College Agricultural Experiment Station has coöperated with the State Board of Agriculture in an inspection of the commercial fertilizers sold in the state.

In accordance with the public statutes, the collection of samples of the different fertilizers has been in charge of the Secretary of the Board of Agriculture, Hon. N. J. Bachelder, who has been assisted by Mr. James A. Foord; while the chemical analyses have been performed under the direction of the chemist of the Experiment Station, Prof. Fred W. Morse, who has had for assistants, Messrs. Chas. D. Howard, Chas. W. Vickery, and Ernest B. MacCready.

The following towns were visited by the agent of the Board of Agriculture, during the spring months, and samples were taken of all brands of fertilizers to be found.

LIST OF TOWNS VISITED BY THE AGENT OF THE BOARD OF AGRICULTURE

Exeter	Rockingham	County
Portsmouth	“	“
Hampton	“	“
Wilton	Hillsborough	“
Nashua	“	“
Peterborough	“	“
Keene	Cheshire	“
Hinsdale	“	“
Walpole	“	“
Charlestown	Sullivan	“
Claremont	“	“
Contoocook	Merrimack	“
Franklin Falls	“	“
Henniker	“	“

Concord	Merrimack	County.
Penacook	"	"
Tilton	Belknap	"
Lakeport	"	"
Laconia	"	"
Rochester	Strafford	"
Dover	"	"
Madbury	"	"
Milton	"	"
Ossipee	Carroll	"
Center Ossipee	"	"
Centerville	"	"
Wolfeborough	"	"
Plymouth	Grafton	"
West Rumney	"	"
Haverhill	"	"
North Haverhill	"	"
Lancaster	Coös	"
Colebrook	"	"

The result was the collection of 258 samples, divided between 112 distinct brands of mixed fertilizers, representing the following manufacturers.

LIST OF MANUFACTURERS

American Fertilizer Co.	3	brands
Bowker Fertilizer Co.	11	"
Bradley Fertilizer Co.	10	"
Baugh & Sons' Co.	4	"
Clark's Cove Fertilizer Co.	3	"
Cleveland Dryer Co.	2	"
Crocker Fertilizer and Chemical Co. (Buffalo)	4	"
Cumberland Bone Phosphate Co.	3	"
L. B. Darling Fertilizer Co.	6	"
John C. Dow & Co.	2	"
E. Frank Coe Co.	6	"
Great Eastern Fertilizer Co.	4	"
D. C. Hawes	1	"

Lister's Agricultural Chemical Works . . .	4 brands
Lowell Fertilizer Co. (Swift's)	8 "
Pacific Guano Co.	4 "
Packers' Union Fertilizer Co.	4 "
Parmenter & Polsey Fertilizer Co. . . .	4 "
Quinnipiac Company	4 "
Read Fertilizer Co.	9 "
Russian Cement Co. (Essex)	4 "
Standard Fertilizer Co.	3 "
Henry F. Tucker Co.	1 "
Walker, Stratman & Co.	4 "
Williams & Clark Fertilizer Co.	4 "

The work of the inspectors in this state cannot be done before the farmers buy their season's stock of fertilizers, because the manufacturers do not, in many cases, place their goods in the hands of the local agents until April 1, or later. Consequently the analyses of the past year must serve as a guide to the composition of the fertilizers on the market for the coming year. The publication of this bulletin has therefore been delayed, with the idea that it will receive more attention now than if issued last fall, and thus it will be more effective in decreasing the use of inferior brands.

COMPOSITION OF MIXED FERTILIZERS COLLECTED BY THE STATE BOARD OF AGRICULTURE, 1897.

Number.	Manufacturer and Brand.	Number of samples.	Nitrogen in 100 Lbs.		Phosphoric Acid in 100 Lbs.							Potassium Oxide in 100 Lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	American Fertilizer Co.												
1	General American for all crops	3	1.65	1.65	.57	5.26	8.82	14.65	9.00	5.83	6.00	2.85	2.00
2	Potato Fertilizer	1	2.47	2.47	.31	5.55	4.96	10.82	......	5.86	6.00	8.82	9.00
3	Alkali Nitrate Phosphate for Grass and Grain	1	3.99	3.90		2.05	10.55	12.60	17.00	2.05	.....	3.35	3.00
	Bowker Fertilizer Co.												
4	Bowker's Hill and Drill Phosphate	5	2.68	2.47	7.28	4.76	1.69	13.73	12.00	12.04	9.00	2.62	2.00
5	Bowker's Farm and Garden Phosphate	4	1.95	1.65	5.03	3.81	3.06	11.90	10.00	8.84	8.00	2.54	2.00
6	Bowker's Sure Crop Phosphate	2	1.06	.75	6.29	3.37	2.74	12.40	10.00	9.66	8.00	1.51	1.00
7	Bowker's Potato and Vegetable Manure	3	2.45	2.50	7.55	2.32	1.90	11.77	10.00	9.87	8.00	4.42	4.00
8	Bowker's Square Brand Bone and Potash	1	1.82	1.50	2.25	7.30	3.67	13.22	12.00	9.55	6.00	2.43	2.00
9	Bowker's Special for Corn, Grain, and Fodder Corn	1	2.25	1.75	7.38	1.88	2.04	11.30	12.00	9.26	6.00	4.36	4.25
10	Bowker's Potash Phosphate	1	.97	.75	5.40	3.81	2.72	11.93	10.00	9.21	8.00	3.65	3.00
11	Stockbridge Manure for Potatoes and Vegetables	4	3.15	3.20	6.56	1.90	1.29	9.75	7.00	8.46	5.00	10.48	10.00
12	Stockbridge Manure for Top-dressing	2	5.02	4.94	4.36	2.42	2.22	9.00	6.00	6.78	4.00	6.79	6.00
13	Stockbridge Manure for Seeding Down	1	2.24	2.25	2.70	3.76	4.82	11.28	10.00	6.46	6.00	10.14	10.00
14	Stockbridge Manure for Corn, Grain, and Fodder Corn	1	2.98	3.00	7.59	1.23	1.58	10.40	10.00	8.82	7.00	7.46	6.00

	Henry F. Tucker Co.													
15	Tucker's Original Bay State Bone Superphosphate	2	2.27	2.00	6.00	4.02	2.20	12.22	11.00	10.02	9.00	2.26	2.00
	Bradley Fertilizer Co.													
16	Bradley's Eclipse Phosphate	5	1.93	1.00	6.18	3.38	2.24	11.80	12.00	9.56	10.00	2.13	1.50
17	Bradley's Corn Phosphate	5	2.27	2.06	6.72	2.78	2.15	11.65	10.00	9.50	9.00	1.76	1.50
18	Bradley's Potato Manure	5	2.42	2.50	4.95	2.30	1.89	9.14	8.00	7.25	6.00	5.80	5.00
19	Bradley's X. L. Superphosphate	5	2.58	2.50	6.29	3.60	2.44	12.33	11.00	9.89	9.00	2.33	2.00
20	Original Coe's Superphosphate	3	2 27	2.05	9.38	.13	2.49	12.00	10.00	9.51	8.00	1.70	1.00
21	Bradley's Complete Manure for Top-dressing	5	5.00	4.95	1.87	5.42	1.56	8.85	6.00	7.29	5.00	2.94	2.50
22	Bradley's Potato Fertilizer	2	2.31	2.06	5.77	3.76	3.27	12.80	11.00	9.53	9.00	3.35	3.25
23	Bradley's Complete Manure for Potatoes and Vegetables	5	3.71	3.73	5.90	2.66	2.06	10.62	9.00	8.56	8.00	6.65	6.00
24	Bradley's Complete Manure with 10 per cent. Potash	1	3.19	3.30	5.45	4.12	1.66	11.23	7.00	9.57	6.00	9.90	10.00
25	Bradley's Seeding Down Manure	2	2.62	2.50	6.64	3.15	2.86	12.65	12.00	9.79	7.00	2.13	2.00
	Baugh & Sons' Co.													
26	The $25.00 Phosphate	1	2.40	2.06	6.95	1.85	3.53	12.33	......	8.80	7.00	1.98	.50
27	Baugh's Special Potato Manure	1	2.10	1.65	6.43	.41	2.31	9.15	7.50	6.84	5.00	10.78	10.00
28	Baugh's General Crop Grower	1	1.36	.82	6.55	2.26	2.10	10.91	......	8.81	8.00	2.25	1.00
29	The Economical Fertilizer	1	2.03	1.65	5.52	2.93	3.90	12.35	......	8.45	7.00	2.67	2.00
	D. C. Hawes.													
30	Granite State Fertilizer	1	2.68	1.85	1.73	3.22	3.18	8.13	6.00	4.95	5.00	3.98	4.00
	Clark's Cove Fertilizer Co.													
31	King Philip Alkaline Guano for Potatoes	1	1.37	1.23	6.02	2.52	1.53	10.07	8.00	8 54	6.50	4.18	3.00
32	Clark's Cove Potato and Tobacco Fertilizer	2	2.82	2.06	5.93	2.97	2.43	11.33	9.00	8.90	8.00	3.71	3.00
33	Clark's Cove Bay State Fertilizer	2	2.20	1.85	5.90	3.28	2.04	11.22	10.00	9.18	8.50	2.53	2.00
	Cleveland Dryer Co.													
34	Cleveland Superphosphate	2	2.23	2.05	5.50	3.39	2.36	11.25	11.00	8.89	9.00	2.16	2.00
35	Cleveland Potato Phosphate	3	2.28	2.05	6.58	2.96	2.75	12.29	10.00	9.54	8.00	3.50	3.00

COMPOSITION OF MIXED FERTILIZERS COLLECTED BY THE STATE BOARD OF AGRICULTURE, 1897.—*Continued.*

Number.	Manufacturer and Brand.	Number of samples.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	CUMBERLAND BONE PHOSPHATE CO.												
36	Cumberland Potato Fertilizer	2	2.39	2.06	4.90	4.11	3.24	12.25	11.00	9.01	9.00	3.28	3.00
37	Cumberland Superphosphate	3	2.23	2.06	5.58	3.71	2.10	11.39	10.00	9.29	8.00	2.16	2.00
38	Cumberland Fertilizer	1	1.20	1.06	6.50	1.91	1.57	9.98	10.00	8.41	8.00	2.21	2.00
	CROKER FERTILIZER AND CHEMICAL CO.												
39	Croker's Ammoniated Corn Phosphate	5	2.01	2.00	7.53	3.14	1.21	11.88	11.00	10.67	10.00	2.04	1.60
40	Croker's Potato, Hop, and Tobacco Phosphate	5	2.25	2.00	7.67	3.09	.84	11.60	11.00	10.76	10.00	3.48	3.25
41	Croker's New Rival Ammoniated Superphosphate	5	1.25	1.23	6.75	3.20	1.28	11.23	11.00	9.95	10.00	1.97	1.60
42	Croker's Superior Rye and Oats Fertilizer	1	.93	.82	6.01	3.25	1.53	10.79	9.00	9.26	8.00	2.12	2.00
	STANDARD FERTILIZER CO.												
43	Standard Fertilizer	1	2.12	2.00	5.58	3.79	2.12	11.49	10.00	9.37	8.00	1.95	2.00
44	Standard Guano	1	1.10	1.06	5.04	2.90	1.66	9.60	10.00	7.94	8.00	2.32	2.00
45	Standard Potato and Tobacco Fertilizer	1	2.26	2.05	5.57	4.13	2.53	12.23	9.00	9.70	8.00	3.42	3.00
	L. B. DARLING FERTILIZER CO.												
46	Darling's Farm Favorite	1	3.07	2.00	3.97	3.84	2.73	10.54	8.00	7.81	6.00	6.53	5.00
47	Darling's Animal Fertilizer	1	3.15	3.30	3.21	5.69	5.08	13.98	10.00	8.90	6.00	4.50	4.00
48	Darling's New Hampshire Special	4	3.19	3.00	3.46	4.55	3.34	11.35	11.00	8.01	8.00	8.00	8.00

49	Darling's Blood, Bone, and Potash	1	4.00	4.50	4.91	3.90	1.97	10.78	9.00	8.81	7.00	8.42	7.00
50	Darling's Potato and Root Crop Manure	1	2.80	2.88	3.53	4.59	5.00	13.12	10.00	8.12	7.00	9.28	7.00
121	Darling's L. I. C. Brand	1	3.67	4.00	2.49	3.67	2.90	9.06	......	6.16	6.00	10.06	10.00
	JOHN C. DOW & CO.												
51	Dow's Nitrogenous Superphosphate for Potatoes	1	1.96	2.06	3.03	7.15	1.02	11.20	......	10.18	8.00	4.55	4.00
52	Dow's Nitrogenous Superphosphate	1	2.42	2.06	3.15	8.91	1.94	14.00	......	12.06	8.00	2.49	1.85
	LOWELL FERTILIZER CO.												
53	Swift's Lowell Animal Brand	2	2.41	2.46	5.45	4.13	1.46	11.04	10.00	9.58	9.00	4.34	4.00
54	Swift's Lowell Fruit and Vine Brand	1	2.41	2.47	4.94	3.58	1.44	9.96	9.00	8.52	8.00	6.35	6.00
55	Swift's Lowell Bone Fertilizer for Corn and Grain	5	2.27	1.65	4.82	2.99	1.72	9.53	9.00	7.81	8.00	3.50	3.00
56	Swift's Lowell Complete Manure for Vegetables	5	2.22	2.00	5.29	3.80	1.54	10.63	9.00	9.09	8.00	3.90	3.50
57	Swift's Lowell Empire Brand	5	1.24	1.23	3.20	3.11	1.94	8.25	8.00	6.31	7.00	2.17	2.00
58	Swift's Lowell Potato Phosphate	4	2.68	2.47	7.25	2.16	1.22	10.63	9.00	9.41	8.00	5.85	6.00
59	Swift's Lowell Lawn Dressing	1	4.60	4.12	5.00	2.48	3.52	11.00	9.00	7.48	8.00	5.36	5.00
60	Swift's Lowell Dissolved Bone and Potash	2	1.57	1.65	6.44	3.07	2.81	12.32	10.00	9.51	9.00	2.17	2.00
	E. FRANK COE CO.												
61	E. F. Coe's Celebrated Special Potato Fertilizer	1	1.77	1.65	7.74	1.78	2.94	12.46	11.00	9.52	9.00	3.80	3.50
62	E. F. Coe's High Grade Ammoniated Bone Superphosphate	3	2.11	2.00	7.61	1.95	2.45	12.01	11.00	9.56	9.00	2.07	1.85
63	E. F. Coe's Celebrated Grass and Grain Fertilizer	3	1.23	.80	8.55	1.84	3.11	13.50	10.00	10.39	9.00	2.01	1.35
64	E. F. Coe's Ground Bone and Potash	1	1.67	2.00	......	2.78	12.40	15.18	......	2.78	......	3.56	2.50
65	E. F. Coe's Columbian Corn Fertilizer	2	1.48	1.20	7.60	1.40	3.66	12.66	11.00	9.00	9.00	2.00	1.85
66	E. F. Coe's Columbian Potato Fertilizer	2	1.45	1.20	7.79	1.83	3.31	12.93	11.00	9.62	9.00	1.97	1.85
	GREAT EASTERN FERTILIZER CO.												
67	Great Eastern Potato Manure	4	2.20	2.06	2.65	5.53	3.12	11.30	9.00	8.18	8.00	4.21	4.00
68	Great Eastern Grass and Oat Fertilizer	1	......	.....	6.53	5.42	1.50	13.45	......	11.95	11.00	2.12	2.00
69	Great Eastern General Fertilizer	3	1.34	.82	3.15	4.33	2.76	10.24	9.00	7.48	8.00	4.13	4.00
70	Great Eastern High Grade Corn Fertilizer	3	2.98	2.88	2.93	4.20	3.55	10.68	9.00	7.13	8.00	2.64	2.00

COMPOSITION OF MIXED FERTILIZERS COLLECTED BY THE STATE BOARD OF AGRICULTURE, 1897—*Continued.*

Number.	Manufacturer and Brand.	Number of samples.	Nitrogen in 100 Lbs.		Phosphoric Acid in 100 Lbs.							Potassium Oxide in 100 Lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Lister's Agricultural Chemical Works.												
71	Lister's Special Potato Fertilizer	5	1.71	1.65	6.88	2.65	2.39	11.92	9.00	9.53	8.00	3.54	3.00
72	Lister's Success Fertilizer	5	1.50	1.24	8.46	1.66	2.52	12.64	11.50	10.12	9.50	2.20	2.00
73	Lister's Seeding Down Fertilizer	3	1.42	1.32	5.92	2.18	2.23	10.33	8.00	8.10	7.00	2.21	2.00
74	Lister's Potato Manure	1	2.39	3.70	8.77	1.18	2.20	12.15	8.50	9.95	7.50	7.65	7.00
	Packer's Union Fertilizer Co.												
76	H. G. Potato Manure	2	2.15	2.06	7.14	1.10	1.85	10.09	9.00	8.24	8.00	6.45	6.00
77	H. G. Wheat, Oats, and Clover Fertilizer	2	......	......	7.01	3.53	2.28	12.82	......	10.54	11.00	1.98	2.00
78	Animal Corn Fertilizer	1	2.64	2.47	7.04	.99	1.94	9.97	9.00	8.03	8.00	2.38	2.00
79	High Grade Universal Fertilizer	1	1.08	.82	6.40	1.61	1.30	9.31	9.00	8.01	8.00	4.99	5.00
	Pacific Guano Co.												
80	Soluble Pacific Guano	5	2.20	2.25	5.77	2.82	2.74	11.33	10.50	8.59	8.50	2.03	2.00
81	Nobsque Guano	1	1.06	1.15	7.07	0.37	2.29	9.73	9.00	7.44	8.00	2.52	2.00
82	Special for Potatoes and Tobacco	2	2.26	2.06	5.20	3.01	3.77	11.98	9.00	8.21	8.00	2.85	3.00
83	A No. 1 Phosphate	1	1.15	1.00	5.59	2.63	1.91	10.13	9.00	8.22	7.00	2.25	1.50
	Parmenter & Posley Fertilizer Co.												
84	Star Brand Superphosphate	1	1.86	1.65	3.98	3.96	1.06	9.00	8.00	7.94	7.00	2.42	2.50
85	Plymouth Rock Brand	1	2.74	2.47	4.54	3.89	1.55	9.98	9.00	8.43	8.00	4.32	4.00
86	Special Potato Fertilizer	1	3.08	3.29	4.81	4.39	2.00	11.20	9.00	9.20	8.00	6.44	7.00
87	A. A. Brand Fertilizer	1	4.38	4.12	3.25	4.21	2.72	10.18	10.00	7.46	9.00	8.80	10.00

	READ FERTILIZER CO.													
88	Read's Standard Superphosphate	4	1.10	.82	6.41	2.11	1.23	9.75	9.00	8.52	8.00	4.09	4.00
89	Read's Sure Catch Fertilizer	2	......	......	4.34	2.32	1.18	7.84	7.00	6.66	6.00	4.50	4.00
90	Vegetable and Vine Fertilizer	3	1.95	1.65	5.06	1.87	1.36	8.29	7.00	6.93	6.00	8.46	8.00
91	Practical Potato Special	4	1.03	.82	4.58	.15	.82	5.55	5.00	4.73	4.00	8.20	8.00
92	Fish, Bone, and Potash	3	2.55	2.47	2.97	1.38	1.63	5.98	5.00	4.35	4.00	4.47	4.00
93	Leader Guano	3	1.05	.82	4.98	2.97	1.10	9.05	8.00	7.95	7.00	2.37	2.00
94	Farmers' Friend Superphosphate	2	2.23	2.06	7.16	2.72	1.71	11.59	10.00	9.88	9.00	2.50	2.00
95	High Grade Farmers' Friend	1	3.61	3.29	4.80	1.45	1.52	7.77	6.00	6.25	5.00	10.02	10.00
96	Cereal Special	1	1.86	1.65	4.38	2.52	1.52	8.42	7.00	6.90	6.00	4.45	4.00
	QUINNIPIAC CO.												
97	Quinnipiac Potato Phosphate	5	2.29	2.05	5.86	2.57	3.48	11.91	9.00	8.43	8.00	3.37	3.00
98	Quinnipiac Corn Manure	5	2.35	2.06	5.40	3.49	3.12	12.01	10.00	8.89	9.00	2.00	1.50
99	Quinnipiac Mohosok Fertilizer	1	1.21	.82	6.26	1.51	1.77	9.54	8.00	7.77	7.00	1.46	1.00
100	Quinnipiac Climax Phosphate	1	1.24	1.03	4.97	2.81	2.35	10.13	9.00	7.78	8.00	2.49	2.00
	RUSSIAN CEMENT CO.												
101	Essex XXX Fish and Potash	5	2.43	2.10	3.07	5.77	5.73	14.57	12.00	8.84	10.00	2.83	2.25
102	Essex Complete Manure for Potatoes, Roots and Vegetables	3	4.34	3.70	4.19	3.66	3.03	10.88	9.00	7.85	7.00	9.05	8.50
103	Essex High Grade Superphosphate	1	2.81	2.50	3.32	5.83	4.70	13.85	11.00	9.15	9.00	4.98	4.00
104	Essex Complete Manure for Corn and Grass	1	3.90	3.70	4.38	4.44	3.30	12.12	9.50	8.82	7.00	9.98	9.50
	WALKER, STRATMAN & CO.												
105	Four-fold Fertilizer	3	1.38	.82	5.87	2.73	2.88	11.48	11.00	8.60	8.00	1.99	1.00
106	Potato Special Fertilizer	2	1.80	1.65	6.46	2.16	3.57	12.19	13.00	8.62	9.00	6.40	5.00
107	Big Bonanza Fertilizer	1	1.78	1.65	7.38	2.56	3.70	13.64	15.00	9.94	11.00	2.58	2.00
108	Smoky City	1	1.75	1.23	9.50	2.03	2.03	13.56	15.00	11.53	12.00	1.18	1.00
	WILLIAMS & CLARK FERTILIZER CO.												
109	W. & C.'s Americus Ammon. Bone and Superphosphate	1	2.72	2.47	6.97	2.37	2.16	11.50	10.00	9.34	9.00	3.14	2.00
110	Prolific Crop Producer	1	1.07	.88	6.45	1.86	1.88	10.19	7.00	8.31	6.00	2.19	1.00
111	Americus Corn Phosphate	1	2.20	2.06	4.57	3.59	3.09	11.25	10.00	8.16	9.00	2.74	1.50
112	Americus Potato and Tobacco Manure	1	2.20	2.06	6.21	2.56	3.20	11.97	9.00	8.77	8.00	4.37	3.00

COMPOSITION OF FERTILIZER CHEMICALS COLLECTED BY THE STATE BOARD OF AGRICULTURE.

	Constituents in 100 Lbs.					
	Nitrogen.	Soluble Phosphoric Acid.	Insoluble Phosphoric Acid.	Total Phosphoric Acid.	Available Phosphoric Acid.	Potash.
Bradley Fertilizer Co.						
Muriate of Potash	....	....	....	....	....	50.00
Sulphate of Ammonia	20.40	....	....	....	....	....
Fine Ground Bone	2.75	....	10.90	19.40	8.50	......
Dissolved Bone Black	....	15.60	.50	16.80	16.30	......
Joseph Breck & Sons.						
Bone Meal for Poultry and Lawns	2.27	....	16.70	18.60	1.90	......
Bowker Fertilizer Co.						
Bowker's Fresh Ground Bone	2.75	....	7.80	18.90	11.10	......
Manchester Slaughtering and Rendering Co.						
Tankage	5.12	....	8.15	17.20	9.05	.....
E. Frank Coe Co.						
Pure Fine Ground Raw Bone	3.75	....	....	18.35	....	......

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS. 1897.

	Cents per pound.
Nitrogen in ammonia salts	13.5
“ nitrates	14.
“ dry and fine ground fish, meat, and blood and in high grade mixed fertilizers	14.
Nitrogen in cotton-seed meal, linseed meal and castor-pomace	12.
Nitrogen in fine ground bone and tankage	13.5
“ medium ground bone and tankage	11.
“ coarse bone and tankage	8.
Phosphoric acid soluble in water	5.5
“ “ “ ammonium citrate (reverted)	5.
“ “ in fine ground bone and tankage	5.
“ “ in medium ground bone and tankage	4.
“ “ in coarse bone and tankage	2.5
“ “ in fine ground fish, cotton-seed meal, linseed meal, castor-pomace, and wood-ashes	5.
“ “ insoluble in mixed fertilizers	2.
Potash as sulphate free from chlorides and in wood ashes	5.
“ “ muriate	4.5

The above values are based on the wholesale market prices for the materials, when sold in large lots at the principal trade centers in New England. The valuation of a ton of any mixed fertilizer based on the above figures will usually fall ten dollars below the retail price at the local agency. This variation includes such fixed charges as cost of mixing, bags, cartage and freight, salaries and commissions of agents, and interest.

FERTILIZER NOTES FOR 1897

BY FRED W. MORSE

Fertilizers, during the year just ended, have been lower in price than ever before, and the indications are that they will be even cheaper during the year to come. The result of the cheapening of the chemical constituents has been to raise the quality of the mixed fertilizers somewhat above the minimum guarantee and consequently there are very few samples showing deficits in their composition. Out of 448 separate guarantees, only 28 failed to either exceed the requirements or come within the limits of error in sampling and analyzing. These exceptions included five guarantees of nitrogen, seven of total phosphoric acid, 14 of available phosphoric acid and two of potash, and were scattered through 24 distinct brands representing 18 different manufacturers, thus indicating that there was no attempt at fraud, but either slight carelessness or accident in mixing and bagging the materials. In no case would the guaranteed value have been noticeably affected.

A study of the tabulated analyses has shown a few points that are of importance to the user of ready mixed chemical fertilizers.

One hundred and twelve different brands of mixed fertilizers are included in the tables. Of these, 56 brands are not guaranteed to contain more than two per cent. of nitrogen, and 51 brands more than two per cent. of potash. Only 15 brands are claimed to contain more than three per cent. of nitrogen and but 17 brands to contain more than six per cent. of potash. On the other hand 73 brands are claimed to contain more than eight per cent. of available phosphoric acid.

It may thus be easily seen that the average buyer of fertilizers is purchasing regularly about four times as much phosphoric acid as nitrogen and from two to four times as much phosphoric acid as potash. The persistent use of the average fertilizer must then result in an accumulation of useless phosphoric acid in the soil, accompanied by an exhaustion of the soil's available nitrogen and potash, and in diminishing crops. On most of our New Hampshire soils such a fertilizer will need to be employed in conjunction with barn-yard manure, to be economical, since the manure will supply the nitrogen and potash, which the fertilizer lacks.

Thirty-one brands are not warranted to contain more than 1.5 per cent. of nitrogen, and have been prepared and placed on the market, because of the demand for cheap fertilizers. Nitrogen is the most expensive ingredient of a fertilizer, costing about three times as much as either potash or available phosphoric acid, and is invariably the constituent to be lowered in a mixed fertilizer in order to reduce the price.

It is only in exceptional soils, such as new ground or land previously heavily manured, that crops will receive nitrogen sufficient for successful growth when such low grade fertilizers are applied. Several letters have been received during the past year, testifying to the disappointment liable to be incurred by the users of fertilizers containing small proportions of active nitrogen.

The buyers of ready-mixed fertilizers should bear in mind that it is as important that they study the composition of the fertilizers as that the station chemist does. In the latter case it is essential to know merely that the analyses and guarantees are alike, while in the former case it is necessary to know that the composition is suitable for the uses intended. The name of a brand is no indication that it is suitable for a special crop. Hardly two manufacturers agree in their special fertilizers for corn and similar crops, while some companies issue not less than three distinct mixtures each for such a crop as potatoes.

It should also be remembered that there is no "best fertilizer" made, but each farmer may by careful observation determine those brands which serve his purpose best, and he should know them by their composition, instead of simply by name or price. A comparison of the constituents of any ten fertilizers reported in the foregoing table should convince the user of commercial fertilizers that they cannot be bought haphazard and return a profit to the buyer. The user must try to find out the class of mixture that he needs and thus avoid purchasing unnecessary ingredients while failing to secure necessary ones.

APPENDIX

PUBLIC STATUTES OF NEW HAMPSHIRE

CHAPTER 126

FERTILIZERS

SECTION 20. Every person manufacturing or importing fertilizers to be sold or offered for sale within this state shall obtain a license from the state treasurer, countersigned and recorded by the secretary of the board of agriculture, authorizing such sale. The license shall be for one year, and the party to whom it is granted shall pay therefor fifty dollars, for the use of the state.

SECT. 21. Every such person shall cause to be affixed to every bag, barrel, or parcel of fertilizer to be sold or offered for sale within this state, a written or printed label which shall correctly state his name, his place of business, the number and date of his license, the name of the fertilizer, the date of its manufacture, the percentage of ammonia, nitrogen, soluble phosphoric acid, insoluble phosphoric acid, potash, and its other constituent parts, and the words, "State of New Hampshire—Licensed." By the term "soluble phosphoric acid" is meant such acid in any form or combination when readily soluble in pure water; and by "insoluble phosphoric acid," such as requires the action of acid to render it thus soluble.

SECT. 22. Any manufacturer or importer of fertilizers for sale within this state who does not obtain a license authorizing such sale, or affix to the bags, barrels, or parcels of fertilizers to be sold or offered for sale in this state a label containing the information required by the preceding section, or who affixes a label to such packages containing false information as to any of said particulars, shall forfeit five hundred dollars for each offense, one half for the use of the prosecutor, and the other half for the use of the state.

SECT. 23. Any person who sells or keeps for sale any fertilizer not labeled as required by Section twenty-one of this chapter, or which has a label affixed thereto giving false information as to any of said particulars, or the sale of which is not duly licensed, shall be fined twenty dollars for the first offense and forty dollars for each subsequent offense, one half for the use of the prosecutor, and the other half for the use of the state.

SECT. 24. The money received for license fees by virtue of Section twenty of this chapter is appropriated for the following purposes: A sufficient sum to pay the College of Agriculture and the Mechanic Arts the actual expenses of making analyses of fertilizers and other substances submitted to the college by the board of agriculture for analysis, and the balance thereof to pay the expenses of farmers' meetings held in winter months under the authority of the board of agriculture.

CHAPTER 12

STATE BOARD OF AGRICULTURE

SECTION 9

DUTIES OF THE SECRETARY

LINE 11. He shall collect samples of fertilizers sold in this state, and any other articles which the interests of agriculture may require, and submit them to the College of Agriculture and the Mechanic Arts for chemical analysis.

Bulletin 50 February, 1898

NEW HAMPSHIRE COLLEGE
AGRICULTURAL EXPERIMENT STATION

DEHORNING CATTLE

BY F. WM. RANE AND H. H. LAMSON

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

NEW HAMPSHIRE COLLEGE

OF

AGRICULTURE AND THE MECHANIC ARTS

AGRICULTURAL EXPERIMENT STATION

DURHAM, N. H.

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The Bulletins of this Station are sent free to any resident of New Hampshire upon application.

DEHORNING CATTLE

I. EXPERIENCE WITH THE COLLEGE HERD

BY F. WM. RANE

Beginning with the years 1885 and 1886, the practice of dehorning cattle has rapidly grown in favor, until at present it is commonly practised in many sections. Illinois is credited with being the first state to advocate it. From the first many have strenuously objected to it, numerous lawsuits resulting therefrom. Most of these prosecutions have taken place under the law for the prevention of cruelty to animals. Many states have had test cases, but no one in the United States, so far as we can learn, has been convicted where the case has been carried to the higher courts. Canada has gone farther than any other country in instigating legal proceedings to settle the question. A commission was appointed by the government, which reported in 1892 in favor of the operation when performed with reasonable skill.

During the past year the college herd was dehorned, the data from which operation form the basis for this bulletin. This is not the first dehorning that has been done in the state. In the northern part it is very commonly practised, while in the southern most of the dehorned animals are those that have been shipped from the north. One farmer who purchased some of these cows was so well pleased with them that he has operated on his remaining herd of twenty-nine animals.

One of last winter's dairy school students, Mr. E. Richardson, and his brother purchased a pair of Keystone clippers two years ago, and after operating upon their own herd, made a business of dehorning for others at the rate of fifteen cents per head. Up to the present time they have dehorned over 1,500 animals in and about Littleton.

Mr. L. J. Miner, of Whitefield, a member of the State Board of Agriculture, tells me that all farmers in his section are more than pleased with dehorning, and that it is quite the exception to see a herd of horned animals. If we can judge other towns in the northern part of the state by these reports, it is safe to conclude that this practice is rapidly gaining in favor throughout this section.

Mr. H. E. Forristall, of Columbia, states that dehorning steers is a financial benefit. He claims that where the horns are off, they put on flesh and retain it, while with horns much of the food and nourishment is spent in exercise and in worrying one another. As an example, a year ago, one of our cows slunk her calf in the pasture, because of another's hooking her. Actual danger of this kind is one of the chief reasons in favor of the practice of removing the horns.

The following notes were obtained through the coöperation of Mr. Leigh Hunt, who was assistant in this department last year. On April 7th last, he, together with the herdsman, dehorned a Jersey grade (Ann), using the Keystone clippers. No special device was constructed for holding the animal, and the work was accomplished by tying her to one of the brick pillars in the barn basement, placing her head against the pillar when the operation was performed. This means of holding the animal did not prove satisfactory. During the struggle after the first horn was removed, she threw her head heavily against the pillar, slightly loosening the uncut horn. After the other was removed, she bled very freely. A bandage with pine tar and cotton-seed meal was then applied. The bleeding continued for about an hour, the bandage checking it to a great extent. The operation was performed about eleven o'clock in the morning. The animal ate very little at noon and was very much excited. At night her food was taken about as usual. On the next and the succeeding days there was but little difference noticeable in her eating. Her milk flow dropped off slightly.

Before operating farther, a strong stanchion was erected, a cut of which is shown in figure 2.

On April 13th, three more Jerseys (Cream Cup, Countess, and Bertha) were dehorned. The operation was performed at three o'clock. Three hours later, the blood had ceased flowing. In the night Cream Cup bled very freely again, making her rather weak by morning, by which time bleeding had ceased. Her appetite was very poor for several days, omitting a few meals altogether. The other two cows suffered very little; they did not eat quite as much food for a few days, but rallied quickly.

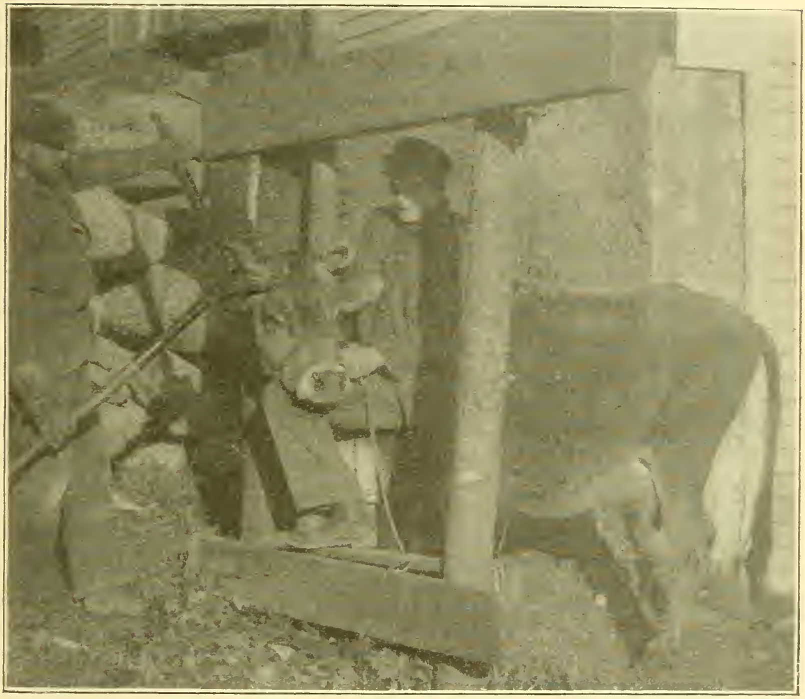


Fig. 2. The stanchion used in dehorning the College herd. Performing the operation.

April 29, the four bulls of the college herd, two Ayrshires, ages sixteen months and five years respectively, a Guernsey, four years, and a Jersey, three years, together with three cows were operated upon. All the horns were easily cut off excepting those of the older bulls, which required an extra man at the handles. When cutting Alton's, the older Ayrshire, one of the handles of the clippers was broken, which we replaced by a strong hickory one. This is liable to occur; hence it is advisable to have an extra handle.

The bulls did not seem to bleed as much as many of the cows, nor for so long a time. They lost little, if any, appetite, and the removal of their horns has made them comparatively quiet and gentle. Up to the present time they have been used for service repeatedly and without any apparent loss of power or inclination. Previous to dehorning, it was our custom to hitch one at a time to a ring and chain, shown on the cover page, this being suspended from a strong cable running the length of the yard, thus giving each daily exercise. This same figure shows the present method; all run together, can be left out longer, and get more exercise from playing with one another, and there is scarcely any danger when handling them, all three being driven in and out together like calves. One can scarcely realize the difference in the amount of work, to say nothing of the lessened danger.

The following day, April 30th, the men dehorned the remainder of the herd, twenty-two cows. The work was begun at about 8 a. m., and all was completed in one hour and forty minutes. The time necessary, therefore, for one operation was on the average only four and one-fourth minutes. In each case, the blood spurted out in a single jet, one from each horn, to a distance varying from three to six feet, gradually subsiding as it began to clot. Nothing was done to check the flow from the last animals, and they stood the test fully as well as the others.

Two Holsteins, one thoroughbred Durham (Dorothy), and a thoroughbred Jersey (Madge Berg 2d), seemed to be the least affected of any of the cows. They scarcely seemed to notice the operation at the time; also recovered quickly. The loss of milk was very small in these cases. One Holstein actually gained in quantity, which, however, was due to the fact that she had calved on the 25th, and had not yet reached the limit of her production. Her increase was constant until the maximum was reached.

In point of breeds, the Ayrshires were the most seriously affected. At the time they seemed to stand it the best, but with the exception of one (Bonnie), they all showed considerable weakness, losing appetite and ambition, besides dropping off in milk and general appearance. Belle,—at the time, the heaviest milker,—seemed to lose the most blood during the night, and her milk flow was reduced from 34.4 pounds to 5.5 pounds the following day, but gradually recovered. Her horns were very large, and difficult to cut. Another Ayrshire (Maid of Chaos) again started to bleed on the following day, but it was easily checked. The loss of blood did not seem to weaken her.

It is now ten months since the operations. All of the animals regained their original vigor in a short time. The general air and disposition of the herd is changed. The former worry and uneasiness, as well as the fierceness previously shown just before feeding times, have disappeared.

CONCLUSIONS

As has already been indicated, it is believed that dehorning not only eliminates the danger to life, and is therefore of the utmost importance; but it has its economic bearing as well. It is well understood, that where milch cows are gently cared for, and not over exercised, other things being equal, more milk is produced. For the same reason it is evident that beef animals will gain more rapidly where hornless, the nourishment exhausted in fighting tendencies being stored up as flesh. Animals are more cheaply transported by live weight, when dehorned, as more can be accommodated in less space and with less danger.

I have yet to see the average herd of horned animals without its recognized leaders and masters; it is nothing more than the atavismic tendencies toward the instincts of the wild animal. Domestication has modified these instincts, but will not overcome them until the implements of warfare are laid aside. Even under domestication, the horns therefore still play an important part in the survival of the fittest.

With our four breeds, it was distinctly shown that such animals, as for example, the Ayrshires, which are noted and bred for their fine horns, suffered the most from dehorning. Next come the Shorthorns or Durhams and the Holsteins, the

Guernseys and Jerseys coming last. In the case of the two last mentioned breeds, many object to the removal of the well-known crumpled horns, which objection might be sustained. However, in the case of the straighter horns, where any possible danger is involved, it is deemed advisable.

For the operation the principal needs for success are as follows :—

(1.) Two men, who are strong, and yet reasonably quiet with the cows. If the animals are excited, it undoubtedly causes more bleeding, and a greater strain upon the constitution.

(2.) A durable stanchion for the operation.

(3.) A good nose or lead ring. This ring takes their attention more than a halter would; also enables the head to be drawn to one side.

(4.) A pleasant day,—that the animals may be turned loose in the yard after the operation.

(5.) The operating place should be near the stable and yard; but not in them, on account of the blood.

(6.) Have extra handles prepared for the machine, so there will be no delay if one breaks.

(7) It is well to have on hand some bandages, pine tar, and absorbents to check the blood flow, should it continue too long.

(8.) The work should not be attempted in fly time.

II. PREVENTING THE GROWTH OF HORNS

BY H. H. LAMSON

Many of the disagreeable features of dehorning may be avoided by preventing the horns of calves from developing.

The horns of cattle consist of two parts of different origin; the outer horny shell is a growth derived from the skin; the inner part or pith consists of bone and is an outgrowth of the skull. See Fig. 3.

At the birth of the calf each of these parts is undeveloped and only exists as a possibility but they at once begin to grow, and in a short time the young horn can be felt as a slight elevation or button.

Bones are covered with a tough, fibrous membrane known as the periosteum, from the inner surface of which new bone is continually being formed upon the surface of the old. It is in this way that growth in size is produced, and it is thus that the bony part of the horn grows.

The horny tissue develops from the skin just as do hoofs and claws in the lower animals and nails in human beings. There is a zone in the skin about the base of the horn known as the matrix, from which new horn-cells are constantly being formed, the older parts being pushed on. If we destroy the periosteum from which the bony part of the horn is formed and the matrix from which the horny part is formed we prevent the further development of the horn. In removing horns which are already more or less developed, as in dehorning mature animals, the cut must be made deep enough to include the matrix or the stump of the horn will continue to grow. It may not be out of place here to remark that there is no danger of cutting into the brain-cavity, as at this point it lies very deeply. The openings frequently seen on removing the horns are only empty spaces with which the frontal bone is honeycombed.

In calves the growing points of the horns are small in extent and can be destroyed with little trouble. This could doubtless be done with a knife but we have had no personal experience as yet on this point. In our experiments we have made use of caustic potash. Caustic potash, so called, is a pure form of the same substance which constitutes the potash sold in cans for soap-making and cleansing purposes. It is in the form of white sticks, in diameter about the size of an ordinary lead-pencil. As its name indicates it is a powerful caustic, rapidly destroying the skin and other tissues if kept in contact with

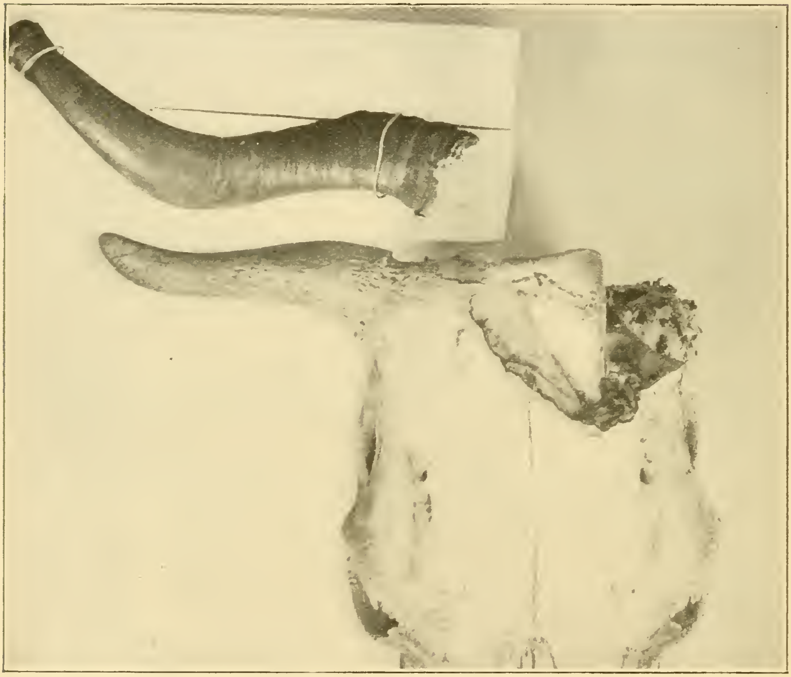


Fig. 3. Skull of a cow, showing the outgrowth of the frontal bone which forms the core or pith of the horn. Above it is the shell or horn tissue proper, which is developed from the skin.

them. In this property lies its value as a preventive of the growth of horns. When properly applied it destroys the matrix or growing point of the horny tissue and the underlying periosteum from which the bony pith grows.

DIRECTIONS FOR USING CAUSTIC POTASH

The hair should be cut away from the young horn as thoroughly as possible so that the potash may come in intimate contact with the parts to be treated. The oily secretion should be removed from the parts to be touched with the potash, by wiping carefully with a rag or sponge moistened with soapsuds, or water containing a little ammonia. *Parts not to be touched should not be moistened.*

The stick of potash is rolled up in a piece of paper so as to leave one end exposed. The exposed end is dipped in water to moisten it and then rubbed on the button or embryo horn until the skin begins to start, care being taken that the whole of the button and the border or matrix is included in the treatment. In young calves a few days old a surface half an inch or a little more in diameter will cover these parts.

Caustic potash, or caustic soda which answers as well, can be obtained at almost any drug store. When not in use it should be kept in a closely-stoppered vial, one with a rubber stopper preferred, or it will liquefy.

After the calf is two or three days old the sooner the potash is applied, the better.

RESULTS OF USING CAUSTIC POTASH

The following is a record of the calves treated;

	Age Jan. 19, 1898.	Date of treatment.	Age at time of treatment.	Result.
No. 1, Pansy,	12 mos.	Feb. 18, '97	5 wks.	Horns not destroyed, somewhat stunted.
No. 2, Martha,	14 mos.	Feb. 28, '97	14 wks.	Ditto.
No. 3, Helen of Troy,	9 mos.	May 1, '97	1 wk.	Both horns destroyed.
No. 4, Madge of Woodstock,	5 mos., 1 wk.	Aug. 28, '97	16 dys.	"
No. 5, Mischief,	20 wks.	Sept. 6, '97	8 dys.	"
No. 6, Marie,	20 wks.	Sept. 6, '97	5 or 6 dys.	"
No. 7, Maid of Beta,	8 wks.	Dec. 11, '97	14 dys.	"
No. 8, Clara,	7 wks.	Dec. 11, '97,	8 dys.	"

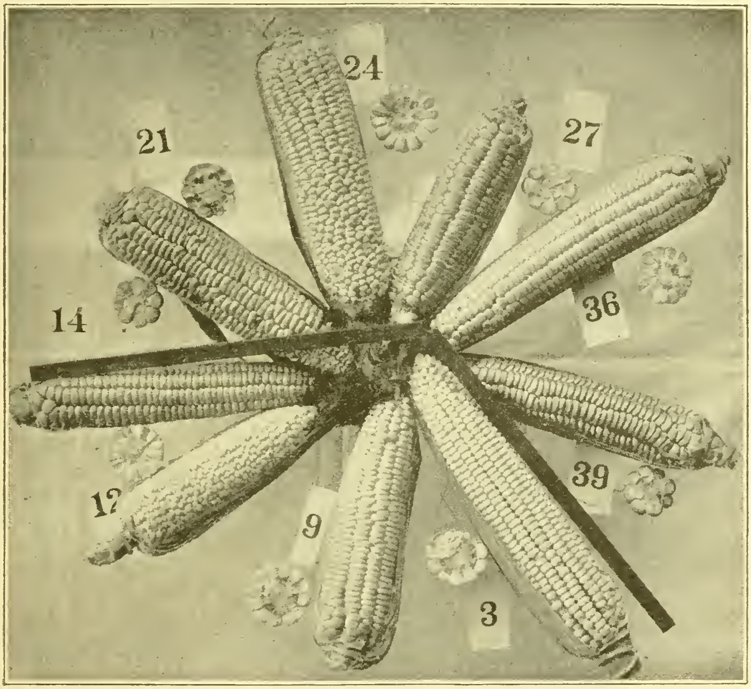
In the cases of Nos. 1 and 2 the treatment was not begun early enough. In the others it was successful.

Bulletin 51 March, 1898

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

SWEET CORN FOR NEW HAMPSHIRE



BY F. WM. RANE

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM, N. H.

NEW HAMPSHIRE COLLEGE

OF

AGRICULTURE AND THE MECHANIC ARTS

AGRICULTURAL EXPERIMENT STATION

DURHAM, N. H.

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The Bulletins of this Station are sent free to any resident of New Hampshire upon application.

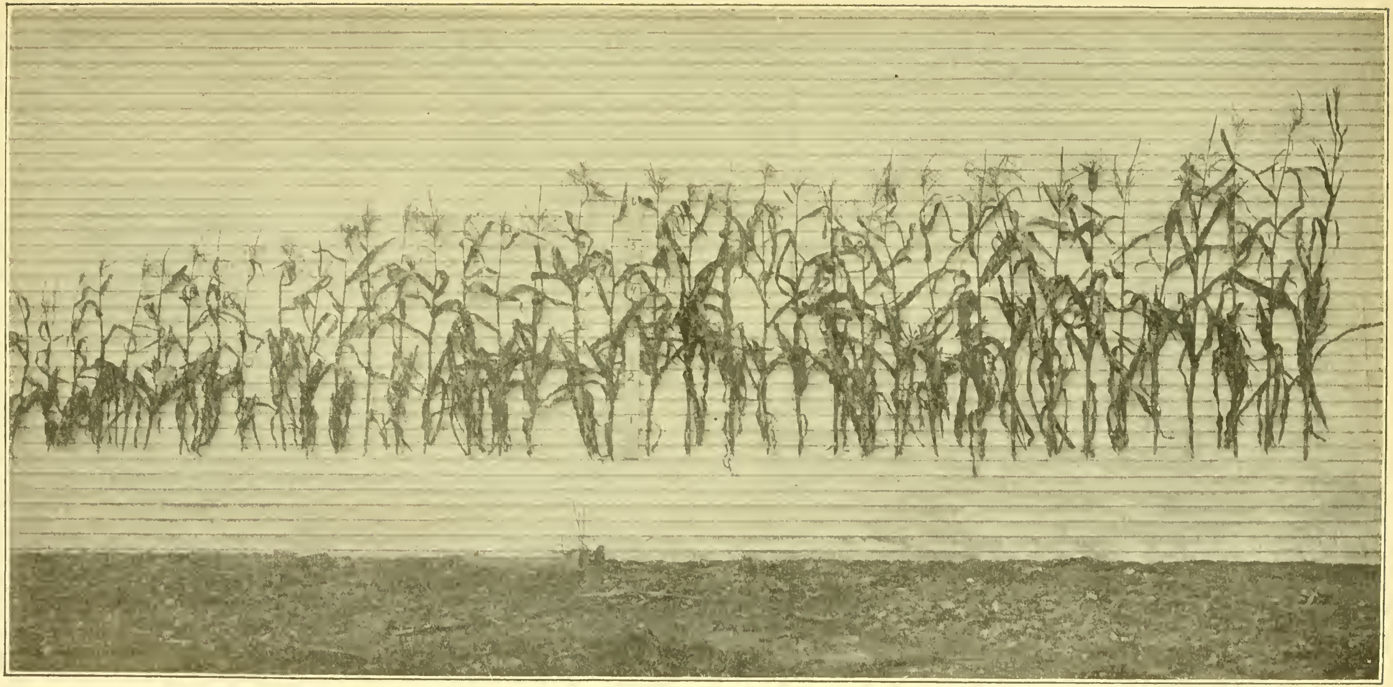
SWEET CORN FOR NEW HAMPSHIRE

F. WM. RANE

One hardly realizes the importance of sweet corn as a food for the human family. It is used not only in its immature or green state, but also in canned and dried form. It is much relished as a food, is highly nutritious and cheap. Nearly every garden contains enough green corn for family use, and doubtless it is as easily grown and cared for as anything there produced. Comparatively little is dried as compared with a quarter of a century ago. Canned corn can now be purchased at such reasonable prices that few prepare their own. The popular New England clam-bake also requires a large amount of corn in some sections.

Where a crop like this one has come into such general favor, there naturally follow with it innumerable varieties. It has been our purpose to investigate the subject of sweet corn as adapted to our needs and conditions. Accordingly forty-one of the more important and highly recommended varieties were grown here at the Experiment Station the past year. The season was somewhat backward for most crops, and corn likewise was retarded, although the favorable condition of a well-drained loam gave very satisfactory results. The soil was light and fairly fertile, a heavy crop of grass having been cut the previous year. It was well covered with rather coarse manure before plowing. A small amount of complete commercial fertilizer was used to start the plants. The ground was well pulverized with the cutaway harrow, smoothed and marked in rows three feet apart. All of the varieties, with the exceptions of numbers 39, 40, and 41, were planted on May 22. These three varieties were not planted until May 26.

When the plants appeared, they were thinned in the first hand-hoeing to 9 inches apart in the row. The ground was cultivated by horse-power three times and a second hand-hoeing given when the weeds had started again. This left the ground clean and friable throughout the season. Table 1 has been compiled from the data obtained from this test. The fruit or ear was the principal factor of importance. Photographs were taken at three different times during the fruiting season, which are shown in figures 1, 3, and 4. The numbers indicate a specimen ear of each variety, also a cross section of the same variety; the names being found in table 1. Figure 2 represents a single average stalk of each variety arranged according to height.



30, 26, 33, 6, 28, 40, 37, 15, 13, 10, 34, 5, 21, 39, 31, 19, 27, 4, 18, 23, 35, 11, 3, 12, 24, 32, 7, 41, 16, 2, 1, 36, 29, 20, 17, 25, 8, 22, 9.

FIG. 2.—An average stalk of the varieties arranged according to height.

TABLE I.—VARIETY TEST OF SWEET CORN.

Number.	VARIETY.	Edible.	Quality.	Yield.		Average height.	Ears.		Smut.
				Av'ge No. ears per plant.	Doz. per acre.		Length.	No. rows of ker-nels.	
1	Stonewall's Evergreen	Sept. 20.	Fair.	1.2	1936	9 ft.	9–10 in.	12	None.
2	Henderson	Sept. 10.	Fair.	1.1	1775	7	9–10	12	Very little,
3	Mammoth	Sept. 25.	Fair.	1.1	1775	7.5	10	12–14	None.
4	Moore's Concord	Sept. 14.	Fair.	.7	1129	6	7–8	12–16	None.
5	Perry's Hybrid	Aug. 23.	Poor.	.9	1452	6.5	6	12	Much.
6	Cory's Early	Aug. 17.	Poor.	.8	1291	4.5	5	8	Very much.
7	Stabler's Early	Sept. 4.	Good.	.8	1291	7.5	9	12	None.
8	Roslyn Hybrid		Good.	1.	1613	8	8	12–16	None.
9	Egyptian	Sept. 20.	Good.	.9	1452	9	8	10–14	None.
10	Early Minnesota	Sept. 1.	Good.	.8	1291	5.5	6	8	None.
11	Squantum	Sept. 15.	Good.	.9	1452	7.5	7	12	None.
12	Country Gentleman	Sept. 14.	Good.	.8	1291	7.5	6	Uneven.	Very little.
13	Crosby's Early	Aug. 21.	Good.	1.	1613	4.5	6	12	Some.
14	White Cob	Aug. 17.	Good.	.8	1291	4.5	6	8	Much.
15	First of All	Aug. 24.	Fair.	2.	3226	5.5	6	12	Considerable.
16	Best of All	Sept. 1.	Good.	.9	1452	6	8	8–10	None.
17	Premier	Sept. 4.	Good.	.7	1129	7	7	8–12	None.
18	First Crop	Sept. 1.	Good.	1.6	2581	7	7	8	Little.
19	New England Sweet	Aug. 27.	Good.	.7	1129	6	7	8	Very little.
20	Early Mammoth	Sept. 20.	Good.	1.	1613	8	9	10–12	Very little.
21	Melrose	Aug. 24.	Poor.	.6	968	5.5	6	10–12	Very little.

TABLE I.—VARIETY TEST OF SWEET CORN.—*Continued.*

Number.	VARIETY.	Edible.	Quality.	Yield.		Average height.	Ears.		Smut.
				Av'ge No. ears per plant.	Doz. per acre.		Length.	No. rows of kernels.	
22	Columbus Market	Sept. 25.	Fair.	1.	1613	9.5	9	14–16	None.
23	Hance's Early	Sept. 15.	Ex. good.	1.2	1936	7	8	8	Very little.
24	Zigzag	Sept. 23.	Fair.	1.3	2097	7.5	7	Uneven.	Very little.
25	Improved Ruby	Sept. 25.	Fair.	.9	1452	8.5	9	12	None.
26	Early Fordhook	Aug. 17.	Good.	.8	1291	4.5	5-7	8	Much.
27	New Champion	Sept. 1.	Good.	.7	1129	6	7	8	None.
28	Telephone	Aug. 21.	Poor.	.9	1452	5	5–8	8	Much.
29	Stowell's Evergreen	Sept. 20.	Good.	1.	1613	9.5	9	12–16	None.
30	First of All	Aug. 17.	Good.	.9	1452	4.5	6	8–10	Some.
31	Adams Extra Early	Sept. 1.	Poor.	1.4	2259	7	8	12	None.
32	Cross	Sept. 15.	Good.	.7	1129	7	7	8	Very little.
33	Eastman's Early	Aug. 17.	Good.	1.1	1775	4	5	8	Much.
34	Extra Early Beverly	Aug. 17.	Good.	1.	1613	5	6	10–12	Little.
35	Asylum Sugar	Sept. 4.	Ex. good.	1.1	1775	7	8	10–12	Very little.
36	Triumph Sugar	Sept. 15.	Good.	1.	1613	7.5	8	12	None.
37	Kendel's Early Market	Aug. 25.	Fair.	1.	1613	6	6	8–12	None.
38	Mammoth White Cory	Aug. 17.	Poor.	1.	1613	4.5	4	8–10	Little.
39	Early Orange	Sept. 4.	Good.	.8	1291	6	7	8	Little.
40	Early Essex	Sept. 4.	Good.	1.	1613	7	8	12	Very little.
41	Squantum	Sept. 4.	Good.	.7	1129	5.5	8	10	None.

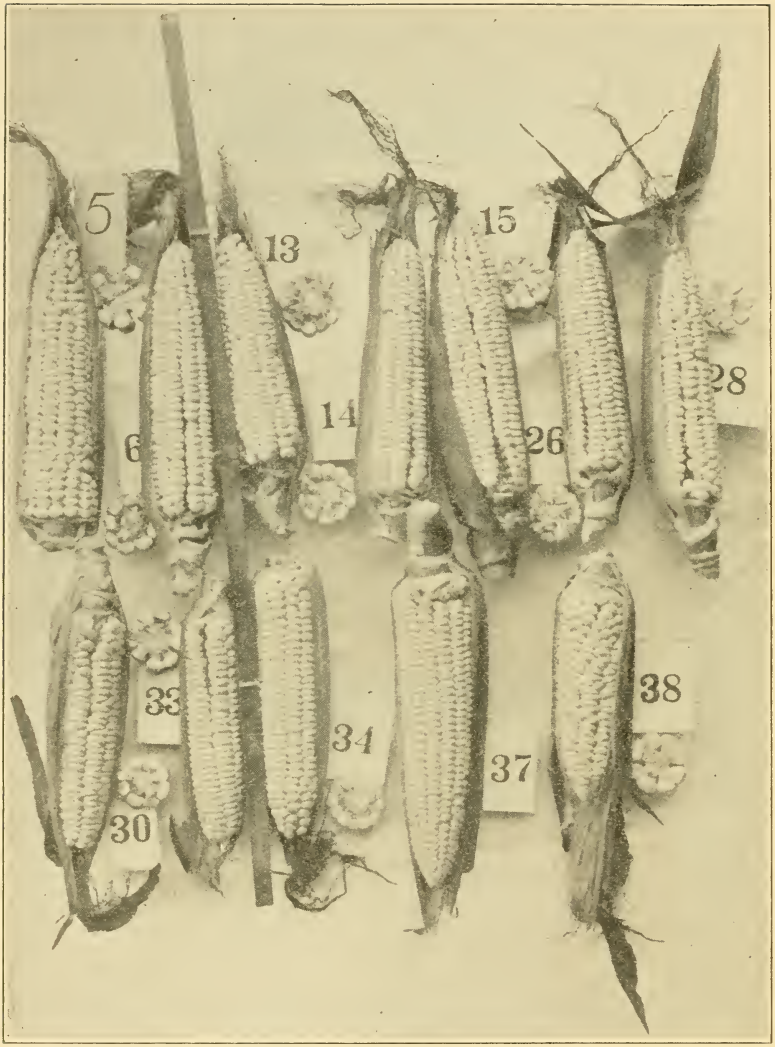


Fig. 3.—Early Varieties.

5. Perry's Hybrid.
6. Cory's Early.
13. Crosby's Early.
14. White Cob.
15. First of All (Buckbee).
26. Early Fordhook.
28. Telephone.
30. First of All (Dreer).
33. Eastman's Early.
34. Extra Early Beverly.
39. Kendel's Early Market.
38. Mammoth White Cob.

The writer is greatly indebted to two of the largest New England canning factories—H. C. Baxter & Bros., and Stone, Brewster & Co.,—for the following information:

H. C. Baxter & Bros. use Early Crosby sweet corn entirely, and claim it does best when planted about eighteen inches to two feet apart between the rows.

Stone, Brewster & Co. use three grades,—the early, medium, and late. The seed is all the product of their own selection and breeding, which has extended over a period of years. The aim of the company is to select with special reference to obtaining fine quality, heavy ears, and compact and deep-set kernels. Their early and medium varieties are "crosses," while their late variety is the "Country Gentleman." The latter is little planted on account of its late and heavy growth, except on river land and with special reference to using the stalks in the silo. Their early variety is as near "Crosby's Early" as anything on the market, and usually is ready for use by August 20th. Their medium variety is an "Evergreen," like "Crosby's" or "Rice's." The ear is large,—12 to 20 rows—good ears often weighing 1 to 1¼ pounds, husked.

Mr. J. R. Brewster says of this variety: "The fodder is large, and it is the popular variety with the patrons of the factory for profit. This usually gets ready to follow the early variety from September 1st to the close of the season, according to location."

This variety is highly valued by the patrons for ensilage, and they claim it is "utterly impossible" to cure sweet-corn fodder so as to pack away in a barn without its rotting.

The factory rules for planting, as given by Mr. Brewster, are: "Early, rows 2½ ft. and hills 2 ft.; Medium Early, rows 2½ ft. each way; Late, 3 ft. each way." The hills are then thinned to four or five stalks, not over four being allowed to grow in the medium and late varieties. The late variety cannot be depended upon to ripen unless it happens to be a late fall.

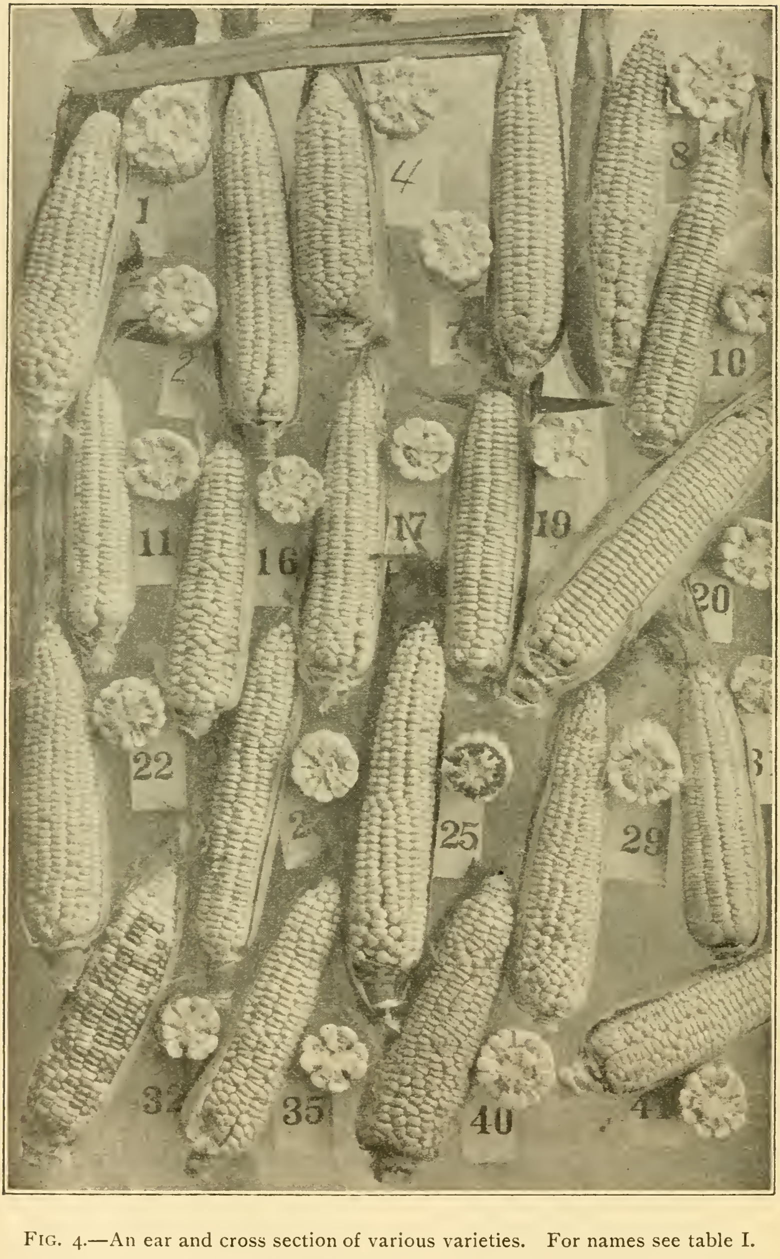


FIG. 4.—An ear and cross section of various varieties. For names see table I.

NOTES ON VARIETIES

1. *Stowell's Evergreen;* (Henderson). A late standard variety, stalk 7–9 ft. high, strong, short-jointed; ear, 25 to 30 in. from the ground, white in color, and 8 to 10 in. long; kernels in rows averaging over 12 in number. Large part of the stalks have two ears. This variety is used some for ensilage corn. It matures about right season for that purpose ordinarily.

2. *Henderson;* (Henderson). A stalwart, short-jointed variety. Stalk averages 7 ft. high. Ears 2½ ft. from the ground, and dull white in color. 9 to 10 inches long, tip fairly filled. Ears rather large in diameter.

3. *Mammoth;* (Henderson). Late, large ear, large cob.

4. *Moore's Concord;* (Henderson). Medium early. Some stalks with no ears; few with two. Dull white color.

5. *Perry's Hybrid;* (Henderson). Poor quality and very variable; one ear in twenty smutty. Few suckers of any size. Dull white to reddish color.

6. *Cory's Early;* (Henderson). One of the earliest to mature. Stools. Ripens all fruit at about same time. Considerable smut, 1 ear in 10. Quality poor.

7. *Stabler's Early;* (Henderson). Medium; white variety. Stalk rather long-jointed.

8. *Roslyn Hybrid;* (Henderson). Late white variety. Quality medium.

9. *Egyptian;* (Henderson). Late white variety. Large tall stalks, resembling No. 1 very much. Ears good size and well filled.

10. *Early Minnesota;* (Henderson). An early white, 8-rowed variety. Not as early as many.

11. *Squantum;* (Henderson). White, medium early variety. Ears good size.

12. *Country Gentleman;* (Henderson). A late variety of comparatively recent introduction. As shown in Fig. 1, No. 12, the kernels are very irregular. Ears medium size and good flavor. Has a good reputation.

13. *Crosby's Early;* (Henderson). A standard, early white variety; height 4½ ft. Good quality, fairly productive; small

cob; sends up numerous suckers. This variety is quite commonly used in the canning factories of the state.

14. *White Cob;* (Henderson). One of the earliest. Very dark green foliage, 5 ft. high, numerous suckers, good-sized kernels, with small cob; good quality; numerous ears under size.

15. *First of All;* (Buckbee). A new large-eared early variety; ears 8 in. long; cob large and not well filled at tip; kernels about medium size. Stalk 5½ ft.; a heavy yielder; quality fair.

16. *Best of All;* (Buckbee). A new early to second early variety. Ears good size, 8 rowed; quality good. Height 6 ft.

17. *Premium;* (Breck & Sons). Medium early white variety; height 7 ft.; not very productive this season. Kernels 8–10 rows; quality good; 1 in 20 smutted.

18. *First Crop;* (Breck & Sons). An early 8-rowed variety. Many stalks had third ear started. Ears not fully filled at tip, 7–8 in. long. Quality good. Very productive this year.

19. *New England Sweet;* (Ferry). Early 8-rowed variety, originating in New England. Fairly productive; sweet; height 6 ft. The ears harden rapidly, quickly passing the edible stage.

20. *Early Mammoth;* (Weeber & Don). This variety is fully a week earlier than Mammoth (No. 3), and far superior. Ears 12-rowed, large, regular. Quality good. Productive.

21. *Melrose;* (Thorburn). Early 10-12 rowed variety. Light yield, many nubbins, quality poor.

22. *Columbus Market;* (Livingston). A second early variety introduced in 1896. It ripened this season with the late varieties. Good size, ears 14-16 rowed; tip well covered. Fair quality.

23. *Hances Early;* (Livingston). Second early white variety. The cob is long, small, and well filled. It ripens at the time when most corn is used and is very sweet. Productive; a valuable variety.

24. *Zigzag;* (Gregory). Late variety, ripening with Country Gentleman (No. 12). A comparatively new variety. Kernels large; ear of good size; quality fair. Name derived from its uneven rows.

25. *Improved Ruby;* (Burpee). A late and novel variety. Both stalks and husks are of a dark red color. Ears large and well filled. Cob dark red. Quality fair.

26. *Early Fordhook;* (Burpee). A new extra early white variety. Ht., four feet, eight inches. A good sized ear, with 8-10 rows, small cob, and large kernels extending to the tip. The rows are regular and present a good appearance. Average yield. Smut, 1 ear in 20. Worthy of trial.

27. *New Champion;* (Johnson & Stokes). Introduced last year. Ht., six feet. Medium sized 8-10 rowed ear. First to second early. Not very productive. Good quality; no smut. The leaves of the plant rusted badly and the corn remained edible only for a short time.

28. *Telephone;* (Salzer). An early variety. Cob medium in size and fairly well filled, although not very closely. Eight rowed and about the average size of the smaller varieties. Ht., five feet; quality poor; color white; average yield.

29. *Stowell's Evergreen;* (Dreer). (Same as No. 1).

30. *First of All;* (Dreer). One week earlier than No. 15 of the same name, also one foot shorter. Av. ht., 4 ft., 6 in. Ear fair size and well covered to the tip. Stools but little. Kernels large and rows mostly regular. Average yield; good quality. But little smut. Worthy of a trial.

31. *Adams Extra Early;* (Dreer). An old standard early variety of poor quality. Its merits are earliness and productiveness. Not a true sweet corn.

32. *Cross;* (from Mr. Powell, Ghent, N. Y.) A novelty of two colors. Ht. 7 ft. Ear 7 in. long; 8-rowed. Second early; good quality.

33. *Eastman's Early;* (Eastman). One of the earliest varieties. Ht. 4 ft., 6 in.; ear 5–6 in. long; cob small and well filled to tip; kernels large; rows regular. Scarcely different in appearance from No. 30. Good quality; above the average yield. Smut 1 ear in 12. Worthy of trial.

34. *Early Beverly;* (Landreth). Fruited with the first; plant 5 ft. tall; ear good size; foliage dark; cob large, well filled; kernels smaller than those of No. 33. Quality good; average yield.

35. *Asylum Sugar;* (Landreth). Medium early white

variety. Stalks 7 ft. Ears large, 10–12 rowed, and somewhat irregular. An old variety. Quality, extra sweet; above the average yield. Valuable.

36. *Triumph Sugar;* (Landreth). Late, white variety; stalk, 7 ft., 6 in. Ear, large, 12-rowed. Average yield; old variety. Good quality.

37. *Kendel's Early Market;* (Livingston). A new variety; large ears; comparatively early. Fair quality, average yield. Promising.

38. *Mammoth White Cory;* (Ferry). Although ripening a few ears early, it is not so early as White Cob (No. 14), or Cory's Early (No. 6). Ear rather short; average yield; poor quality.

39. *Early Orange;* (Dunlap). A deep, golden-colored corn. Stalk 6 feet in height, rather slender; not quite up to the average in productiveness; quality good; 8 rowed. A distinct variety.

40. *Early Essex*; (Dunlap). Medium early this year. Good flavor; large ear, well-filled; 12–16 rows, comparatively small cob. Very little smut. Good yield.

41. *Squantum;* (Dunlap). Same as No. 11.

SUMMARY

1. Unless under the most favorable conditions, the late varieties of sweet corn cannot be depended upon for a full crop in New Hampshire.

2. The average date of the first killing frost for New Hampshire for the past fifty years is October 3,—the earliest, August 7, and latest, October 30. The killing frosts of spring are over on the average May 6.*

The dates of the first general heavy and killing frosts for New Hampshire in recent years are: 1885, September 24; 1886, September 21 to 25; 1887, September 26; 1888, September 6 and 7; 1889, September 23; 1890, September 30; 1891, very late; 1892, very late, October; 1893, October 17; 1894, September 11 to 13; 1895, September 14 to 16; 1896, September 23; 1897, September 22.†

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* Bailey's Principles of Fruit-Growing, data taken from U. S. Weather Bureau.

† U. S. Weather Bureau, New England section.—J. W. Smith.

3. The *Extra Early Varieties* were: Eastman's Early, Extra Early Beverly, Mammoth White Cory, First of All (No. 30), Early Fordhook, Cory's Early, and White Cob. These are named in order of productiveness.

4. The *Early Varieties* were: Crosby's Early, Telephone, Perry's Hybrid, First of All (No. 15), Melrose, Kendel's Early Market, New England Sweet, Adams's Extra Early, Early Essex, Early Minnesota, and Early Orange. Named in order of earliness.

5. Those ripening *Medium Early* were: First Crop, Best of All, New Champion, Asylum Sugar, Squantum, and Moore's Concord.

6. The *Late Varieties* were: Henderson, Country Gentleman, Hance's Early, Triumph Sugar, Cross, Stowell's Evergreen, Early Mammoth, Egyptian, Zigzag, Mammoth, and Columbus Market. Named in order of earliness.

7. The date of planting this season was May 22; and the average number of days required to mature each class was: Extra Early 88, Standard Early 95, Medium Early 102, and Late 110 or more.

8. The following varieties were of *poor quality*: Cory's Early, Perry's Hybrid, Melrose, Telephone, Adams's Extra Early, Mammoth White Cory.

9. For *sweetness* Hance's Early, Squantum, and Asylum Sugar were pronounced.

10. Two *varieties of interest* were: Improved Ruby and Early Orange. The stalks and husks of the former were scarlet and the white kernels set in red hulls. The latter was a deep orange-colored ear, accompanied with a peculiar though not objectionable flavor.

11. A distinct type of extra early sweet corn is found in the four varieties: Eastman's Early, First of All (No. 30), Early Fordhook, and White Cob. These are all very early, sweet, eight rowed, well filled, and of fair size.

12. The Extra Early Beverly was the only extra early 10-12 row variety of good quality.

13. Crosby's Early, although not as early as the earliest by a few days, still remains the standard early variety.

14. The best results from growing sweet corn with commer-

cial fertilizers have come in using the following mixture per acre: Dissolved bone-black 370 lbs., muriate of potash 73⅓ lbs., and sulphate of ammonia 73⅓ lbs.*

15. The varieties making the best general showing were: For *Extra Early*, Extra Early Beverly, Eastman's Early, Early Fordhook, First of All (No. 30), and White Cob; for *Standard Early*, Crosby's Early; for *Medium*, Asylum Sugar, First Crop, Early Essex, Squantum; for *Late*, Hance's Early, Triumph Sugar, Stowell's Evergreen, and Country Gentleman.

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Bulletin 52 April, 1898

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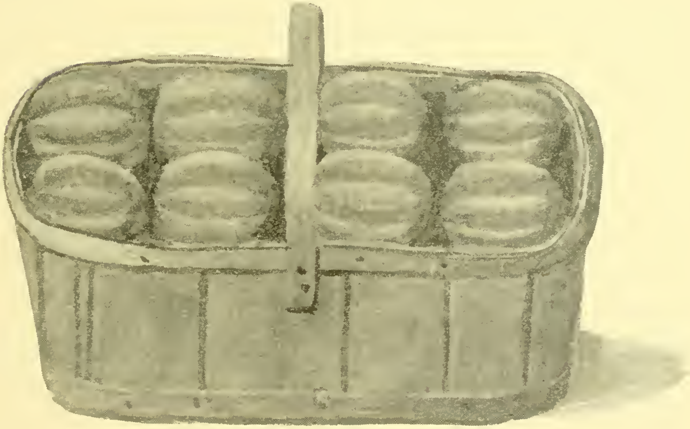
AGRICULTURAL EXPERIMENT STATION

GROWING
MUSKMELONS
IN THE NORTH



BY F. WM. RANE

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BULLETINS OF 1898

Bulletin 49—Inspection of Fertilizers. January.
Bulletin 50—Dehorning Cattle. February.
Bulletin 51—Sweet Corn in New Hampshire. March.
Bulletin 52—Growing Muskmelons in the North. April.

GROWING MUSKMELONS IN THE NORTH

F. WM. RANE

I. INTRODUCTION

All things considered, there is probably nothing grown in the garden that equals the muskmelon as a delicacy. The fruit has been grown from a very early date, and is supposed to be a native of the hotter parts of Asia, whence it has been introduced all over the world. Writers tell us that in some parts of the Orient, where the melon grows readily in the open air, it forms one of the chief articles of food.[1] In England the melon is very highly prized as a dessert fruit. It is, however, comparatively a luxury, glass houses or frames with artificial heat being necessary for success with it. In this country, owing to our vast range of climatic conditions, it has become, through continuous breeding, adaptable to a wide range of territory.

In the more temperate regions the area devoted to it is so large that in season, such markets as that of Baltimore handle daily trainloads of this fruit. In 1894 the writer visited the market just named. It was about eight o'clock in the morning, and although they had been unloading since daylight, they were still busily engaged. Boats of all sizes,—sloops, cat-boats, pungies, etc.,—103 in number, were lying at the wharves, all heavily laden and waiting their turn for unloading. Across the street fully two hundred teams were also waiting to dispose of their fruit. At the commission houses the melons were sorted and crated in boxes, barrels, or one-half bushel baskets for shipment. The melon is largely grown in New Jersey, Delaware and Maryland, throughout the Ohio and Mississippi valleys, about Norfolk, and to a greater or less extent by all gardeners about our larger cities.

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[1] Nicholson's Dictionary of Gardening.

While the demands of the city markets are met doubtless from the sources named, the average town, village, and country homes are usually without it. It is unfortunate that country grocers and fruit stands should be compelled to send to the commission merchants for this delicacy. There seems to be no reason why it could not be grown and offered for sale by the local gardeners and farmers, or at least enjoyed by the family as the product of the home garden. The melon is none too good for the farmer's own family, and should he be so successful that he has a few to spare, by putting them into the milk-cart, when going to town, or in the case of the gardener, with his other vegetables, there is little doubt but that he would find a ready sale.

We find that comparatively few melons are raised in this state. This is, we believe, partly due to the following reasons:

(1). Comparatively few people understand their culture.
(2). Trouble from insects.
(3). They do not mature early enough.
(4). Insufficient knowledge of varieties.

The selection of varieties seems to be one great point of error. We are usually disappointed in the fruit offered on the menus of hotels; it is almost invariably inedible. Possibly the size of the fruit may have some bearing on the subject. It is quite evident at the fairs that size rather than quality is sought. With the melon, more than any other fruit, increase in size beyond the average is accompanied by a corresponding decrease in flavor. At present, however, the markets are changing in this respect, and there is a growing demand for the smaller varieties, which are sold in half-bushel baskets, about sixteen melons to the basket, as shown on the cover page. The ordinary peach basket was first used, but the market basket with a handle is rapidly displacing it.

II. EXPERIENCE WITH MUSKMELONS AT THIS STATION

It is to create, if possible, more interest in this fruit, and thereby to increase its general production, that we give the following data.

The melon was first grown at the station in 1895, from seeds sent out by the United States Department of Agriculture—and with good success. In 1896 the experiments were continued by a test of thirty-six varieties.

During the past season, seventy-two varieties were grown, including those of the previous year. As far as possible the seed was purchased from the introducer, that it might be pure and true to name. There is perhaps no fruit that deteriorates more quickly than the melon when even slightly neglected in seed selection. The seed of all varieties was sown on May 29th. The season was if anything an inferior one for most garden crops, there being comparatively few days at a time when it did not rain.

The soil was a friable clay loam which had been under cultivation the previous year. It was fairly fertile, having been used for a strawberry bed two years before. The muskmelon is not as particular in regard to soil as the watermelon. It will do fairly well on any soil provided it is well-drained and friable. Generally speaking, any soil suited to the cucumber will grow the muskmelon ; a light soil is preferable on account of easy cultivation and earliness. It should be of sufficient elevation to guarantee good drainage. The melon asks for soil with only average fertility ; too rich a soil induces abundant vines, resulting in poorer quality and lateness of fruit. A soil containing a generous supply of humus or vegetable matter is best for the melon ; where this is not already in the soil it can be supplied by plowing under coarse manure or various green manures.

Manuring. The next thing of importance is to have a well-decomposed compost for use in making the hills, where it is thoroughly mixed with the soil. The hills were five by six feet apart, the usual distance, which allows 1,452 hills per acre. The compost is best when mixed a year in advance. It is made by piling up manure, keeping it moist and allowing decomposition to set in. Should hen, sheep, or horse manure be used, it is always best to mix them with soil before st~~o~~acking. Early in spring, sometime before using, the heap is cut down and shoveled over in order to pulverize it. One or two good shovelfuls per hill is sufficient. Should the compost lack in nitrogenous constituents, ~~as do those named,~~ it is well to add a handful of finely ground bone to each hill, working it well into the mixture of soil and compost. Unleached wood ashes are used with good results by mixing in a similar manner. They do not, however, take the place of the ground bone. Much depends upon the condition of both soil and compost as to the amount of ingredients or manures to be used.

Where commercial fertilizer alone is to be used the following formula has been recommended :[1]

For Nitrogen	(1)	180 to 360 lbs. nitrate of soda ; or
	(2)	150 to 300 lbs. sulphate of ammonia ; or
	(3)	300 to 600 lbs. dried blood.
Phosphoric Acid	(1)	500 to 1,000 lbs, bone meal ; or
	(2)	350 to 700 lbs. dissolved bone, etc.; or
	(3)	400 to 800 lbs. dissolved rock.
Potash	(1)	130 to 260 lbs. muriate ; or
	(2)	130 to 260 lbs. sulphate ; or
	(3)	1,300 to 2,600 lbs. wood-ashes.

Too much nitrogen is to be avoided as the tendency will be to run to vine rather than fruit. The potash may be applied in the fall, also one-half the phosphoric acid ; but the remainder should be applied in spring.

Cultivation. The ground having been in cultivation the previous year, was not plowed until early spring. Fall plowing has many advantages for melon growing, provided the land is not too rolling and therefore liable to wash. By the action of frost the soil becomes friable, insects are to a great degree destroyed, and the land may be worked earlier in the spring.

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[1] New York Agricultural Experiment Station, Bulletin No. 94, New Series.

When the plowing is done in spring, it should be performed early that the material turned under may have time to at least partially decompose before the roots begin feeding upon them. A heavy soil is plowed and worked more deeply than a lighter one. It should be well pulverized before making the hills.

After planting cultivation was continued both to a good depth and at comparatively frequent intervals. As the plants grew larger, it was lessened, until, when the foliage occupied most of the area, it was stopped altogether. The amount of hand hoeing depends upon the weediness of the ground but should be resorted to at least every week or ten days at first to keep the plants growing. After heavy, dashing storms or in extremely dry weather a slight amount of hoeing loosens up the soil.

Planting and thinning. The soil was marked out, five by six feet, and the hills made at the intersections. When a shovel plow is used, it requires but little work with a hoe to prepare each hole for receiving the compost. The compost is next added and mixed in each hill with about equal parts of the loose soil. This fills the hole level full when well firmed. Each hill is then slightly raised by drawing the loose dirt over the compost to a depth of one and one-half inches.

The seed of all the varieties was planted on May 29th. From fifteen to twenty seeds were placed in each hill to insure against failure in germination, insect troubles, etc. The seed should always be planted sidewise or flat for best results in germination. They were pressed into the soil and covered not over one inch in depth. By firming the soil in the usual way with the back of the hoe, germination is hastened. As soon as the plants were sufficiently established, they were thinned to four plants in the hill.

Pruning or pinching off the end of the vine is often resorted to when the plants are a few feet in length in order to force out the lateral growth which bears the fruit. This is seldom practised, however, by large growers. It is advisable to remove all fruit that sets too late to mature in order to strengthen the others.

TABLE 1.—COMPARISON OF VARIETIES OF MUSKMELONS

(Yield calculated from two hills of each variety. Hills 5x6 feet apart.)

Number.	VARIETY.	Date of ripening.	No. of fruits ripened.	Average weight of ripe fruit.	No. of fruits of good size on vines Sept. 27.	Average No. of ripe fruit per acre.
				Lbs.		
1	Apple-shaped Cantaloupe	Sept. 9	....	... .	....	
2	Triumph........................	“ 9	4	1.3	4	2904
3	Extra Early Grand Rapids	“ 9	6	1.9	9	4356
4	Melrose........................	“ 9	1	....	....	726
5	Cannon Ball...	“ 9	2	2	9	1452
6	Green-fleshed Osage..............	“ 9	2	2.3	11	1452
7	Cosmopolitan..................	“ 9	14	2.5	5	10164
8	Netted Beauty.....................	Failed.	. ...	....	....	
9	Golden Gem.......................	“	....	....	....	
10	Captain...........................	Sept. 9	7	.9	8	5082
11	No. 88......	“ 9	7	1.2	9	5082
12	Lone Star..........................	“ 9	2	5.1	7	1452
13	Miller's Cream Nutmeg...........	“ 9	3	2.5	16	2178
14	Jersey Belle.......................	“ 9	6	1.7	10	4356
15	Mango	“ 9	6	2.6	....	4356
16	Emerald Gem......................	“ 9	6	.4	30	4356
17	Hackensack........................	“ 9	2	3.3	2	1452
18	Newport...........................	“ 9	4	.8	12	2904
19	Perfected Delmonico..............	“ 9	3	1 7	13	2178
20	Banquet	“ 9	2	3	17	1452
21	Market.......	“ 9	5	3	17	3630
22	Tip-Top............................	“ 9	2	3.8	10	1452
23	Rose Gem	“ 9	5	1.3	22	3630
24	Sill's Hybrid......................	“ 9	5	2.3	10	3630
25	Long Island Beauty...............	“ 9	3	3.5	14	2178
26	Six Oaks Cantaloupe.............	“ 9	3	2.2	5	2178
27	New Hybrid........................	“ 9	....	....	....	
28	Triumph............	“ 9	2	3.9	2	1452
29	Earliest Ripe......................	“ 9	6	1.6	15	4356
30	Cosmopolitan	“ 9	5	3	7	3630
31	Ironclad	“ 9	4	2.9	7	2904
32	Satisfaction.......................	“ 9	5	2.4	10	3630
33	Jenny Lind........................	“ 9	2	.9	22	1452
34	Columbus....................	“ 9	3	2.5	4	2178
35	Pineapple	“ 9	2	2	17	1452
36	Seedling—Hybrid Nutmeg........	Failed.	....	....	....	
37	Granite State......................	Sept. 2	7	3.6	11	5082
38	Carmes	“ 9	2	3.3	10	1452
39	Shumway's Giant..................	“ 9	4	3.2	3	2904
40	Montreal Nutmeg..................	“ 9	17	3.6	14	12342
41	Early Nutmeg......................	“ 9	6	1.8	14	4356
42	Osage..............................	“ 9	3	3	8	2178
43	Bay View.........................	“ 9	4	2.9	9	2904
44	Delmonico......	“ 9	3	3	14	2178
45	Extra Early Hackensack	“ 9	6	2.1	7	4356
46	New White Japan.................	“ 9	6	1.8	11	4356
47	Skillman's Fine Netted...........	“ 9	4	2.5	11	2904
48	Christiana.........................	“ 9	3	2.5	5	2178
49	Extra Early Cantaloupe	“ 9	6	1.9	9	4356
50	Champion Market.................	“ 9	1	2.9	9	726
51	Banana	“ 9	3	3.1	4	2178
52	Surprise	“ 9	6	2.7	8	4356
53	Chicago Nutmeg..................	“ 9	2	2	8	1452
54	Long Yellow.............	“ 9	9	4.2	7	6534
55	Irondequoit	“ 20	1	.5	3	726
56	Casaba..............	“ 9	2	3.7	14	1452
57	Golden-Netted Gem.............	“ 9	6	1	22	4356
58	Bird Cantaloupe..................	“ 9	3	3.1	7	2178
59	Missouri...........................	“ 9	3	2.1	10	2178

COMPARISON OF VARIETIES OF MUSKMELONS.—*Continued.*

(Yield calculated from two hills of each variety. Hills 5x6 feet apart.)

Number.	VARIETY	Date of ripening.	No. of fruits ripened.	Average weight of ripe fruit.	No. of fruits of good size on vines Sept. 27.	Average No. of ripe fruit per acre.
				Lbs.		
60	Large White French	Sept. 9	2	3.9	2	1452
61	Netted Nutmeg	" 9	5	2.8	10	3630
62	Large Black Paris	" 9	1	3.5	....	726
63	Anne Arundel	" 20	2	2.1	1	1452
64	Atlantic City	" 9	3	2.8	13	2178
65	Improved Jenney	" 15	2	3.1	7	1452
66	Acme	" 9	3	1.3	15	2178
67	Citron	" 9	2	3.3	11	1452
68	Ward's Nectar	" 9	2	1.9	15	1452
69	McCotter's Pride	" 9	2	1.7	2	1452
70	Shippers' Delight	" 9	2	1	9	1452
71	Togoodo	" 9	....	....	....	
72	Ivy Gem	" 9	2	2.7	12	1452

The first fruit to ripen during the past season was on September 2, just 97 days from planting. The majority took about 103 days. Much depends upon the season as to the time necessary for maturing this crop. For the data of all varieties, see Table I. Photographs were taken to show the characteristics of each variety, which are reproduced in Plates I, II, and III. The last column in the table has been computed to show the average yield of ripe fruit per acre, that it might be compared with other staple crops.

At first glance, when a variety yields but two ripe melons per hill, it appears an unprofitable investment. Calculation proves, however, that this is a yield of 2,904 melons per acre, which at the price of five cents each would give a return of $145.20. From ten to twelve melons is not an uncommon yield per hill, in which case the returns would be of course proportionately larger.

Table II is compiled from the various catalogues, to show the characteristics of each variety grown. Such descriptions as "beautifully netted," "excellently netted," etc., are not especially definite; also the maximum rather than the average in size is likely to be given.

Insects are sometimes very troublesome. Those causing the greatest trouble were the small yellow leaf-beetles—the striped cucumber beetle *(Diabrotica vittata)*, yellow with black stripes, and the spotted cucumber beetle *(D. 12-punctata)*, yellow with 12 black spots on its back. These insects live over winter under leaves, rubbish, etc., and begin their attack as soon as the first two cotyledonous leaves make their appearance. They are very active, and if the vines are neglected even for a day when the insects are numerous, they will be practically destroyed. By liberally spreading tobacco dust upon and around the plantlets as soon as the insects made their appearance, we were able to keep them off. The dust can be purchased from seedsmen at two dollars per 100 pounds, or five cents per single pound. We have tried nearly everything, and this seems to be the most effective. The other insect liable to be troublesome is the common squash bug. We were, however, troubled very little by it. The best remedy is to hand-pick and destroy it in the cooler portions of the day. If boards are placed about the hills, they will take refuge under them. Its eggs, which are usually laid in clusters on the leaves, are also easily destroyed.

Worms and insects do more or less damage by working into the melon where the fruit comes in contact with the ground. This is easily overcome by placing something under the fruit—small pieces of board, stones, etc.

Fungous diseases are quite prevalent in melon-growing sections. The only one affecting our plantation was the mildew, which was quite serious with some varieties, causing the fruit to become distorted and in some cases worthless. It is found upon both the leaf and fruit. The remedy is to spray with the Bordeaux mixture.

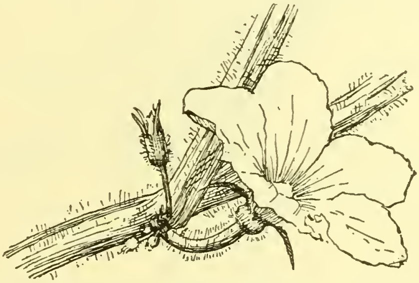


FIG. 1.—Staminate or Male Blossom. (After Bailey.)

The Fertilization of the flowers we believe was much retarded during the past season, which fact doubtless accounts in one way for the comparatively small yield of ripe fruit. The muskmelon depends almost wholly upon insects for the fertilization of its flowers. Owing to the great amount of wet weather and the little sunshine during the time the first flowers were in bloom, these creatures could not assist in fertilization to any marked degree. Plenty of fruit set later in the season on most varieties, as is shown by the number of green fruits in Table I. The muskmelon is monœcious; that is, the sexes are born in separate flowers on the same plant. The first flowers to open are those of the male, which are always more numerous than the females. These flowers are easily distinguished; the female has a melon-like development at the base of the calyx while the male has none. Compare Figures 1 and 2.

This season we expect to hand-fertilize the flowers to see if the operation is useful.

Miscellaneous.—The small-sized varieties were more productive than the large. Also, the rule so frequently quoted, "The finer netted, the sweeter the fruit," has too many exceptions to be relied upon. With some varieties a good index as to ripeness is the cracking about the stem ; many, however, do not have this tendency.

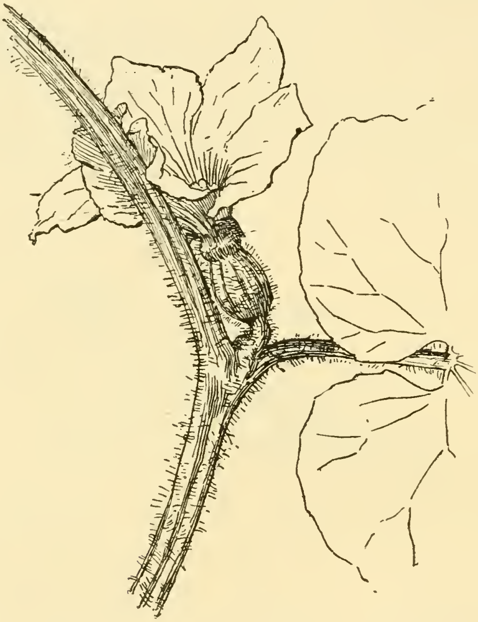


FIG. 2.—Pistillate or Female Blossom. (After Bailey.)

To ship melons far it is necessary to pick them when at full size, but still green. They are, however, much superior when ripened upon the vines. Early melons are obtained by starting the seed in two- or three-inch pots, or in sods, etc., one plant in a pot ; then transplanting into a four-inch pot ; from these hardening off in a cold frame ; they are then ready for the garden (see Figure 3). We fruited a few varieties in cold frames. The sash was used at first, but was discarded as soon as the outside temperature sufficiently modified. It took 115 days for fruit so handled to ripen.

The writer has also forced the muskmelon in the greenhouse with success, but refers the reader to the more elaborate work of Professor Bailey on "Winter Muskmelons," Bulletin 95 of the Cornell University Experiment Station, 1895.

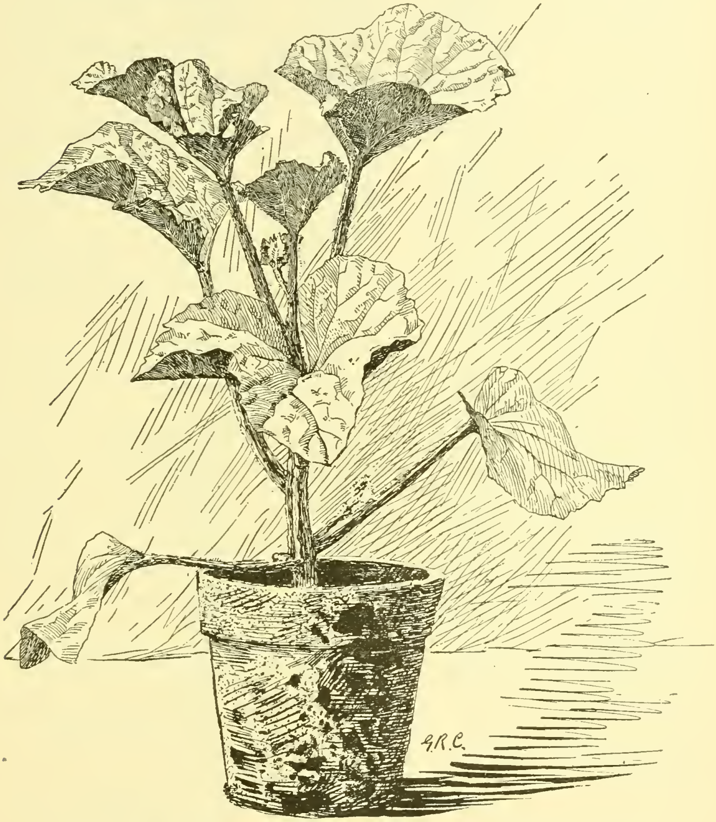


Fig. 3.—Muskmelon Plant ready to Transplant. (After Bailey.)

CANTALOUPE

The term cantaloupe when used to designate muskmelons is usually very misleading. A cantaloupe is a melon having a scaly or rough skin, of the warty appearance of the Hubbard

TABLE II.—CHARACTERISTICS OF EACH VARIETY FROM CATALOGUES

No.	Color of Flesh.	Shape.	Size.	Outside Characters.
1	Bright salmon.	Apple shape.	Small.	Yellow, mottled with light green spots.
2	Red salmon.	Round.	Large.	Beautifully netted.
3	Salmon.	Round.	Large.	Ribbed and densely netted.
4	Clear light green.	Oval.	About 4 lbs.	Dark green, densely netted, shallow ribs.
5	Green.	Round.	6 in.–8in. diam.	Heavily netted.
6	Pea green.	Egg-shape.	Medium.	Heavily netted and green color.
7	Green.	Round.	Medium.	Heavily netted.
8	Pale green.	Oval.	Medium.	Completely covered with dense netting.
9	Light green.	Round.	About 2 lbs.	Green and thickly netted.
10	Green.	Round.	Small.	Ribbed and thickly netted.
11	Green.	Oblate.	Small.	Has a "button" on blossom end.
12	Salmon.	Oblong.	Large.	Free from ribs and heavily netted.
13	Salmon.	Oblong.	Medium.	Dark-green color and finely netted.
14	Green.	Oblate.	Small.	Deeply ribbed and heavily netted.
16	Salmon.	Oval.	Small.	Emerald-green and smooth.
17	Green.	Oblate.	5-10 lbs.	Deeply ribbed, coarsely netted.
18	Green.	Round.	Small.	Rich golden, evenly netted, ribs shallow.
19	Orange-pink.	Globular.	Large.	Bright yellow, ribs wide, thickly netted.
20	Salmon.	Round.	Medium.	Beautifully netted, without ribs.
21	Green.	Round.	Medium.	Close and strong netting.
22	Yellow.	Round.	Medium.	Thickly netted.
23	Green.	Oval.	Medium.	Slightly ribbed and netted.
24	Salmon.	Round.	Medium.	Ribbed and netted.
25	Green.	Oblate.	Medium.	Densely netted and ribbed.
26	Green.	Round.	Large.	Deeply ribbed, well netted.
28	Red-salmon.	Oval.	10-15 lbs.	Beautifully netted.
29	Green.	Round.	9-11 lbs.	Dark green and heavily netted.
30	Green.	Round.	Large.	Light green, without ribs, silver-gray netting.
31	Deep yellow.	Round.	Medium.	Heavy coarse netting.
32	Yellow.		Large.	Green.
33	Green.	Oblate.	Very small.	Ribbed and covered with shallow netting.
34	Green.	Round.	Medium.	Glossy yellow, ribs shallow, white netting.
35	Light green.	Oblong.	15-16 lbs.	Rich yellow color, skin corrugated.
37		Oblong.	Large.	Deeply ribbed, greenish yellow.
38	Salmon.			Very dark green colored, ribs deep, slightly netted.
39	Light salmon.	Round.	Large.	Yellowish-green.
40	Green.	Oblate.	Very large.	Densely netted, green skin.
41	Green.	Round.	Medium.	
42	Salmon.	Round.	Medium.	Dark green, slightly ribbed, shallow netted.
43	Green.	Oblong.	Large.	Ribbed and densely netted.

Table II.—CHARACTERISTICS OF EACH VARIETY FROM CATALOGUES

No.	Color of Flesh.	Shape.	Size.	Outside Characters.
44	Orange pink.	Oval.	Large.	Heavily netted.
45	Green.	Round.	Medium.	Ribbed and coarsely netted.
46	Greenish white.	Oval.	Medium.	White and smooth.
47	Green.	Oval.	Medium.	Shallow ribbed and netted.
48	Yellow.			Green.
49	Green.	Oblate.	Medium.	Heavily netted and showy.
50	Light green.	Globular.	4-5 lbs.	Deeply ribbed and heavily netted.
51	Rich salmon.	Long.	18 in-24 in. long.	Creamy white.
52	Salmon.	Oval.	Large.	Cream colored.
53	Green.		Large.	Thickly netted.
54	Salmon.	Oval.	Large.	Deeply ribbed.
55	Salmon.	Oval.	Large.	Shallow ribbed and thickly netted.
56	Green.	Oblong.	Large.	Green, becoming yellow on ripening.
57	Light green.	Round.	Small.	Excellently netted and regularly ribbed.
58	Light green.		Very large.	
59	Green.	Globular.		Wonderfully ribbed and strongly netted.
60	Yellow.	Oblong.	Large.	Yellow, deeply ribbed, slightly netted.
61	Green.	Round.		Dark green, netted.
62	Deep orange.	Oblong.	Very large.	Black, ribs broad and deep, netted.
63	Green.	Oval.	Large.	Ribs distinct and netted all over.
64	Green.	Oval.	Large.	Moderately ribbed and heavily netted.
65	Green.	Round.	Small.	Green.
66	Green.	Oval.	Large.	Pointed at both ends and strongly netted.
67	Orange.	Globular.	Large.	Webbed and ribbed.
68	Green.	Round.	Small.	Finely netted.
69	Orange red.	Round.	Very large.	Evenly and moderately ribbed, dark green, netted.
70	Green.	Round.	Large.	Ribbed and heavily netted.
71	Yellowish green.	Oval.	Large.	Bright, mottled with gray.
72	Deep salmon.	Round.	Large.	Cream-yellow and deeply ribbed, nearly smooth.

squash, and is generally deeply furrowed when ribbed. Various sections of the country have construed the term very differently, some applying it to the yellow-fleshed, and others to the green-fleshed varieties; still others make it applicable to large or small fruit. The term is generally used incorrectly in catalogues. Comparatively few cantaloupes are raised in this country; in European countries they are considered a fruit of delicious flavor.

NOTES ON VARIETIES

The following general notes were taken September 18th; for exterior appearance consult the photographs of each variety in Plates I, II, III:

2. *Triumph* (Burpee). Vines medium strong; fruit round, 5 inches in diameter, netted without ribs. Average productiveness; fair quality.

3. *Grand Rapids* (Burpee). Strong vigorous vines; fruit 7 inches long by 5 inches thick, netted and ribbed, salmon flesh. Well matured and prolific.

5. *Cannon Ball* (Burpee). Fruit round, netted, no ribs, 5 inches in diameter, light green flesh. It cracks open before ripe, is only medium productive and late.

6. *Green-fleshed Osage* (Johnson & Stokes). Fruit black, smooth, medium ribbed. Size 4½ by 5½ inches; prolific, inclined to wartiness; too late this season.

7. *Cosmopolitan* (Burpee). Same as No. 30. Productive.

10. *Captain* (Johnson & Stokes). Fruit round and flat at the ends, ribbed, 4 inches in diameter and 3 inches thick, netted. Vines fairly prolific but not extra strong; some fruit ripen when very small, some also not as flat shaped as others. Flesh green, matures, excellent quality, 9½ on scale of 10.

11. *No. 88* (J. and S.). Vines small but productive. Fruit 3½ by 3½ inches, each melon having a button on the blossom end. Shape round, netted and ribbed; good quality, flesh green.

12. *Lone Star* (J. and S.). The fruit was somewhat variable, size ranging from 5 by 7 to 9 by 7 inches; about one-half were smooth, others netted and ribbed. When ribbed it has a tendency to crack when ripening. Flesh yellow, and very fair quality, 8½. Originated in Texas.

13. *Miller's Cream* (Henderson). This variety is sometimes called Osage, but the above name is preferred to distinguish it from the green-fleshed Osage variety. Fruit 5 by 6 inches, dark green, ribbed. Flesh sweet and salmon color. Prolific but somewhat backward this season.

14. *Jersey Belle* (J. and S.). Fruit netted and ribbed, 4 by 5 inches, broader than long, slightly darkish in color. Flesh green with a whitish tendency, quality good, 8. Productive.

15. *Mango* (Breck & Sons). Fruit matures 5 by 8 inches, ribbed, netted. Leaf three lobed.

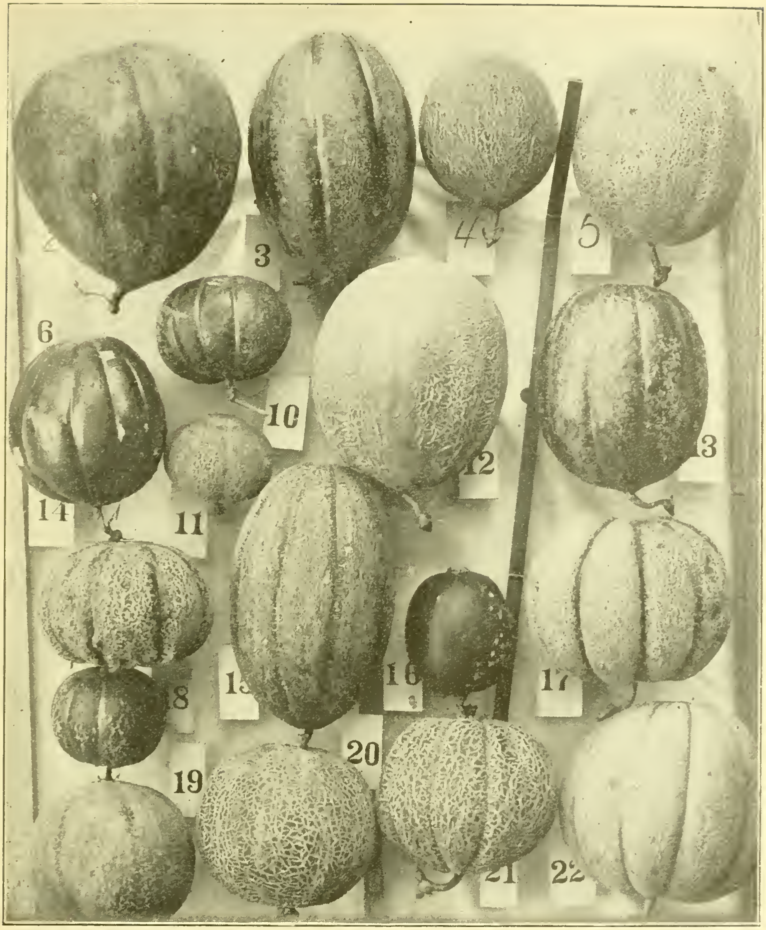


PLATE I.—VARIETIES OF MUSKMELONS.

2. Triumph.
3. Extra Early Grand Rapids.
4. Melrose.
5. Cannon Ball.
6. Green Fleshed Osage.
10. Captain.
11. No. 88.
12. Lone Star.
13. Miller's Cream.
14. Jersey Belle.
15. Mango.
16. Emerald Gem.
17. Hackensack.
18. Newport.
19. Perfected Delmonico.
20. Banquet.
21. Market.
22. Tip Top.

16. *Emerald Gem* (Breck & Sons). Vines thrifty, small round, smooth fruit, with a netted tendency; 2½ by 2½ to 3 by 3 inches. Not up to standard for this variety.

17. *Hackensack* (Henderson). Large round, 5 by 7 inches, flattened, ribbed, green flesh. A standard variety, but not so productive as usual this year.

18. *Newport* (Henderson). Small round melons, fairly productive. Slightly dark, ribbed, and netted. Flesh green and of good quality.

19. *Perfected Delmonico* (Henderson). Round, smooth melon 4½ inches in diameter. Flesh orange color and fine quality. This variety had a tendency to crack at the tip end this season which was an objectionable feature.

20. *Banquet* (Henderson). A medium sized melon, averaging 4 by 5 inches the largest being 5½ by 6. The vines were well filled, but the fruit was backward. Without ribs but heavily netted. This variety is quite commonly grown and is considered a standard among salmon-fleshed varieties.

21. *Market* (Livingston). Round, 6 by 6 inches, netted, ribbed. Productive. Same maturity as 20.

22. *Tip Top* (Livingston). About same size as 21, smooth to slightly netted, ribbed, lightish color. Not very prolific this season; quality good 8½, yellow flesh.

23. *Rose Gem* (Livingston). A small melon averages 4 inches in diameter. Netted, slightly ribbed, productive. Flesh dark green, quality good 8½. A fine melon.

24. *Sills Hybrid* (Gregory). Medium round, ribbed, smooth or slightly netted, giving a mottled appearance. Flesh yellow, above the average in quality 9. Productive.

25. *Long Island Beauty* (Gregory). Round, deeply ribbed, heavily netted, Hackensack in type. Fairly productive.

26. *Six Oaks Cantaloupe* (Gregory). Not very thrifty, fruit distorted and warty; flesh green, fine flavor, moderately productive, late. Undesirable in this year's test.

28. *Triumph* (Buckbee). Fruit large, 6½x7½ inches, dark green and very smooth. Flesh salmon color; only moderately productive.

29. *Earliest Ripe* (Salzer). Small melon, 4 inches in diameter, round, netted, slightly ribbed, Emerald Gem type. Not extra early, productive, good quality 9½; desirable.

30. *Cosmopolitan* (Ferry). "Fruit slightly oval, nearly round, without ribs, Color light green, but covered at maturity with dense silver-gray netting." Flesh green. Average size, 5x6 inches. Productive.

31. *Ironclad* (Vaughn). Of somewhat the same shape and size as 30 except being slightly ribbed. Flesh salmon, flavor good 8½; fairly productive.

32. *Satisfaction* (Farquhar). Resembles Miller's Cream but is more round in shape, 6x6 inches. Yellow flesh, good quality 85 to 95; productive.

33. *Jenny Lind* (Dreer). Small green-fleshed melon, globular or a little flattened, ribbed and covered with a shallow netting. Many fruit set but not fully ripe.

34. *Columbus* (Dreer). Smooth light green, a tendency toward nettedness

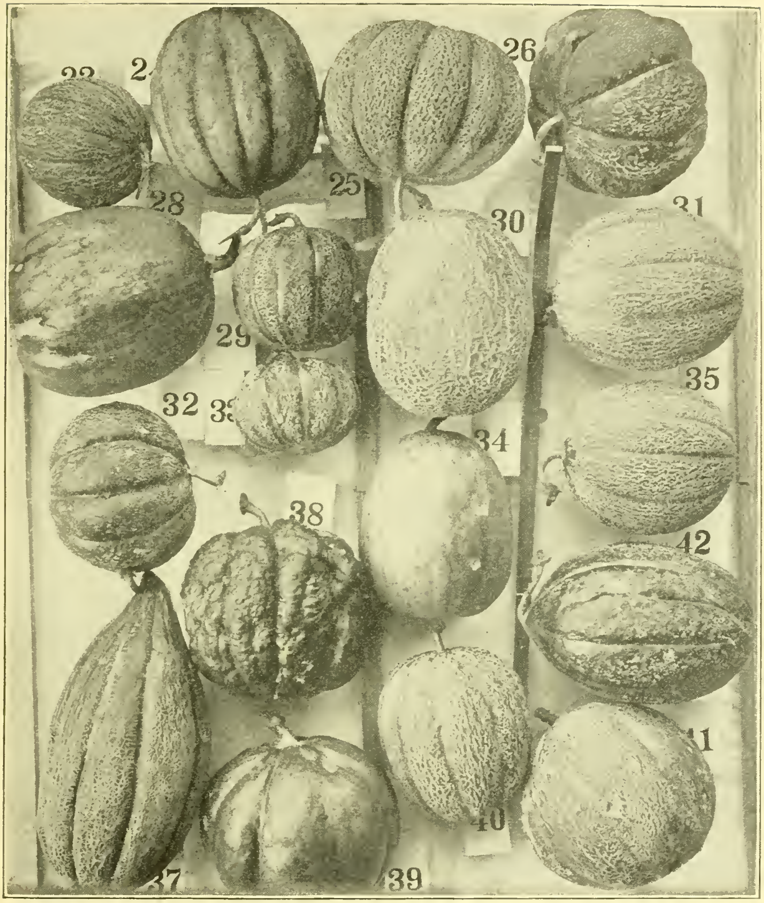


Plate II.—Varieties of Muskmelons.

23. Rose Gem.
24. Sill's Hybrid.
25. Long Island Beauty.
26. Six Oaks Cantaloupe.
28. Triumph.
29. Earliest Ripe.
30. Cosmopolitan.
31. Ironclad.
32. Satisfaction.
33. Jenny Lind.
34. Columbus.
35. Pine Apple.
37. Granite State.
38. Carmes.
39. Shumway's Giant.
40. Montreal Nutmeg.
41. Early Nutmeg,
42. Osage.

but many perfectly smooth, 4x5 inches; elongated, a few round. Not many fruit on vine but a large percentage mature.

35. *Pine Apple* (May). Elongated, 4x5 inches, Hackensack type, light green flesh, good flavor 95, fairly productive.

37. *Granite State* (Eastman Seed Co.). Large, long fruit, darkish green, netted and ribbed, size 9 to 11 inches long and 5 to 5½ inches thick. Very productive and sustains its reputation for earliness; it was the first to mature this season. The flavor was not up to the average, which may have been caused by the season. Worthy of trial for a large fruiting variety.

38. *Cormes* (Henderson). Fair size, 5½ inches in diameter, round, black, deep-ribbed, warty. Has a Hubbard squash appearance.

39. *Shumway's Giant* (Gregory). Light color, smooth, round, 6x6 inches, slightly ribbed but not netted. Light salmon flesh. Average productiveness.

40. *Montreal Nutmeg* (Gregory). Large, darkish-nutmeg, globular, 6x6 inches, green-fleshed, uniform in shape, ribbed, netted. The most productive of any this season.

41. *Early Nutmeg* (Gregory). Common nutmeg size, average 5 inches in diameter, green flesh, ribbed, netted, productive.

42. *Osage* (Gregory). Dark green, ribbed, elongated, slightly netted, average size 5½ by 7 inches, fairly productive. A strain of Miller's Cream No. 13.

43. *Bay View* (Gregory). Elongated, 4½x9 inches, slightly ribbed, long striped netting, green flesh, average productiveness.

44. *Delmonico* (Gregory). Large, roundish, 6x7½ inches, elongated, ribbed, large coarse netting. Average productiveness, orange flesh, good flavor.

45. *Extra Early Hackensack* (Gregory). Round and regular nutmeg Hackensack form. Above the average in productiveness.

46. *New White Japan* (Gregorv). Smooth, whitish, round to oblong, slightly ribbed, 5x6 inches. Flavor not as good as usual this season. Productive.

47. *Spillman's Fine Netted* (Gregory). Resembles Banquet excepting a slight tendency to produce ribs. Flesh green, quality good 8½, average productiveness.

48. *Christiana* (Gregory). Dark green, fair size, deeply ribbed. Resembles Carmes (No. 38), but is not so much distorted.

49. *Extra Early Cantaloupe* (Gregory). Fruit darkish, slightly elongated, 4 to 5 inches in diameter, ribbed, finely netted, productive, green flesh, flavor good 9.

50. *Champion Market* (Gregory). Fairly good size, Hackensack type, light green flesh, too late this season.

51. *Banana* (Gregory). General banana form, grayish green, smooth surface, flesh yellow, average length this season one foot, poor quality.

52 *Surprise* (Gregory). Round, grayish-green, smooth, slightly ribbed, 6 inches in diameter. Whitish flesh, fair flavor 7. White Japan type.

53. *Chicago Nutmeg* (Gregory). Not a typical nutmeg variety. Dark greenish appearance, very little netted, round, fair size; late, not very productive.

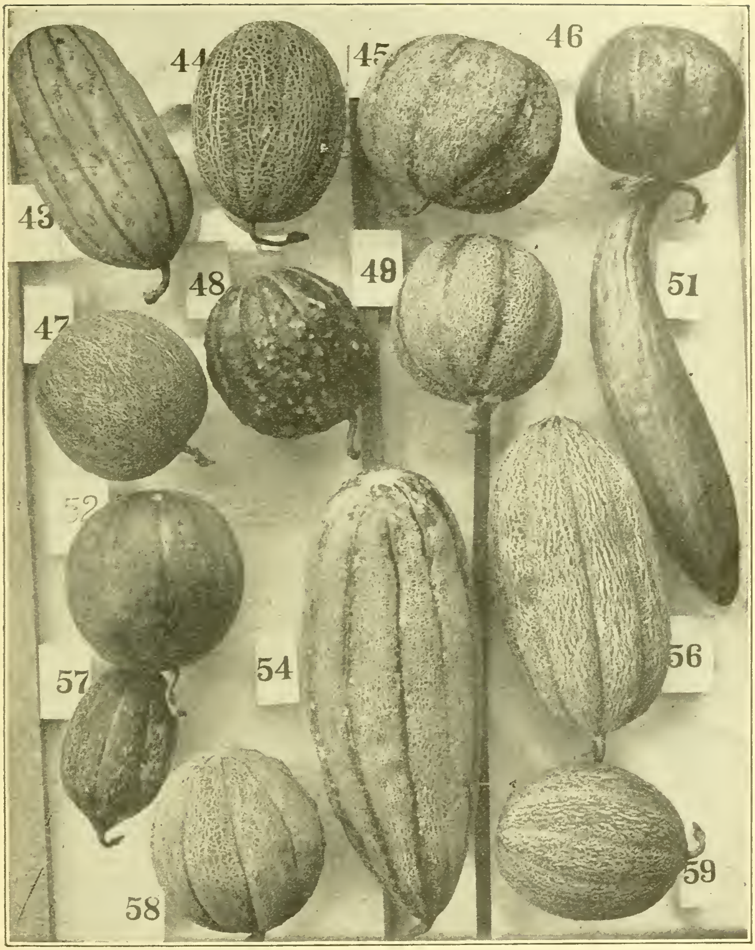


Plate III.—Varieties of Muskmelons.

43. Bay View.
44. Delmonico.
45. Extra Early Hackensack.
46. New White Japan.
47. Skillman's Fine Netted.
48. Christiana.
49. Extra Early Canteloupe.
51. Banana.
52. Surprise.
54. Long Yellow.
56. Casaba.
57. Golden Netted Gem.
58. Bird Cantaloupe.
59. Missouri.

54. *Long Yellow* (Gregory). Large fruit 7x13 inches, ribbed, netted, yellow flesh, large cavity, fair flavor 8, very productive. A valuable large variety.

55. *Irondequoit* (Gregory). Smooth dark green variety of the Miller's Cream type. Immature and undesirable here this season.

56. *Casaba* (Gregory). A large, long, green-fleshed variety, 5 by 9 inches, tendency to nettedness, ribbed. Too late for this season.

57. *Golden Netted Gem* (Gregory). Small, round to oblong, slightly netted, ribbed. Above the average in productiveness, green-fleshed.

58. *Bird Cantaloupe* (Gregory). Irregular in form and size. Some smooth and others netted.

59. *Missouri* (Landreth & Sons). Small, round, or globular in form, flattened at each end, ribbed and netted; flesh green, medium productiveness.

60. *Large White French* (Landreth). Oblong melon of large size, 5½ by 9 inches. Color whitish green turning to yellow when ripe; flesh orange. Not very productive this season. Resembles No. 43 but is larger.

61. *Netted Nutmeg* (Landreth). Round, fairly productive; dark green, ribbed, slightly netted, flavor not up to standard. Resembles No. 45, but is more regular in form.

62. *Large Black Paris* (Landreth). Many vines and but few fruit. Ribbed and slightly netted; flesh yellow. Has the appearance of No. 42 with a slightly larger diameter.

63. *Anne Arundel* (Landreth). Large melon, 6 by 8½ inches, ribs very distinct and heavily netted. Flesh green. Not very many fruit to the hill and too late this season.

64. *Atlantic City* (Landreth). Medium in size, pine apple in shape, 5 by 8 inches, dark background netted and ribbed. Flesh green, medium productiveness. Closely resembles No. 59.

65. *Improved Jenny* (Landreth). A typical dark green Hackensack type. Fruit very uniform, 5½ inches in diameter; lightish green flesh of fair quality.

66. *Acme* (Landreth). Dark green, small, oblong, 4 by 5½ inches; peaked at stem end. Flesh green, productive but late this season. Ribbed and netted. Resembles No. 29.

67. *Citron* (Landreth). Large, dark green, ribbed, partly netted and rest smooth, rather distorted, all sizes. Similar to No. 49 but more flat at the ends.

68. *Ward's Nectar* (Gregory). Dark, round, 4½ inches in diameter, ribbed, smooth and one-half netted, fairly productive but few ripened. Flesh green. Resembles No. 32.

69. *McCotter's Pride* (Ferry). Large vines; fruit irregular, roundish, dark green; ribbed, slightly netted, orange red flesh. Not very productive and late this season. Like No. 46, but more netted.

70. *Shipper's Delight* (Johnson & Stokes). Same as No. 11.

71. *Togoodo* (Johnson & Stokes). Good sized, light green, smooth melons. Not sufficiently mature. Plants not very strong.

72. *Ivy Gem* (Johnson & Stokes). Medium size, yellow-fleshed sort; skin

smooth to slightly netted, lightish in color, ribbed; globular in form, not very productive this season; good quality. Size and appearance of No. 52, but deeper ribbed.

PARTIAL SUMMARY

1. The reasons for failure with muskmelons seem to be insufficient culture, destructive insects, careless selection of varieties, and lack of fertilization of the blossoms. (Pages 50 and 57.)

2. Well-drained soils containing considerable humus or vegetable matter are the best for muskmelons The lighter soils are preferable. (Page 51.)

3. The best fertilizer is one rich in all the elements of plant food, except stimulating nitrogen. (Page 51.)

4. Frequent cultivation and hand hoeing is of great importance. The growth from the first should be continuous. Once checked, the vines seldom regain their original vigor and productiveness. (Page 52.)

5. Plant sufficient seed so that from three to five good plants can be depended upon. (Page 53.)

6. For the cucumber or squash beetles, dust with tobacco; for the common black squash bug, collect and destroy the eggs and the insects, in the cooler portion of the day. (Page 56.)

7. The varieties grown last season are easily classified into four sizes which are as follows:—

Small Varieties were: Captain, No. 88, Emerald Gem, Newport, Rose Gem, Earliest Ripe, Jenny Lind, Golden-Netted Gem, Shippers' Delight.

Medium-sized Varieties: Melrose, Green-Fleshed Osage, Jersey Belle, Perfected Delmonico, Banquet, Market, Satisfaction, Pineapple, Montreal Nutmeg, Early Nutmeg, New White Japan, Skillman's Fine-Netted, Christiana, Extra Early Cantaloupe, Chicago Nutmeg, Bird Cantaloupe, Missouri, Netted Nutmeg, Acme, Citron, Ward's Nectar, McCotter's Pride, Ivy Gem.

Large Varieties: Extra Early Grand Rapids, Cannon Ball, Miller's Cream Nutmeg, Mango, Hackensack, Tip Top, Sill's Hybird, Long Island Beauty, Six Oaks Cantaloupe, Cosmopolitan, Ironclad, Columbus, Carmes, Osage, Bay View, Delmonico, Extra Early Hackensack, Surprise, Irondequoit, Large Black Paris, Anne Arundel, Atlantic City.

Extra Large Varieties: Triumph, Lone Star, Granite State, Shumway's Giant, Banana, Long Yellow, Casaba, Large White French.

8. The *varieties of best flavor*, as shown in the past season's test, were: For *Small*, Captain, No. 88, Newport, Golden Netted-Gem, Earliest Ripe, Rose Gem, Jenny Lind, Shippers' Delight; for *Medium*, Perfected Delmonico, Pineapple, Extra Early Cantaloupe, Satisfaction, Skillman's Fine Netted, Improved Jenney, Jersey Belle, Ivy Gem, Banquet, Market, Netted Nutmeg; for *Large*, Sill's Hybrid, Tip Top, Ironclad, Miller's Cream, Delmonico, Long Island Beauty, Six Oaks Cantaloupe, Surprise; for *Extra Large*, Lone Star, Long Yellow, Triumph.

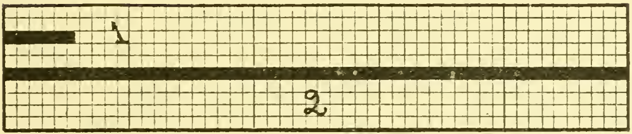
Bulletin 53 May 1898

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

THE FARM WATER SUPPLY

BY FRED W. MORSE.



COMPARISON OF NATURAL AND POLLUTED WATERS.

1. Chlorine in normal spring water, less than 0.6 part in 100,000 parts of water.
2. Chlorine in many well waters, 5.0 parts in 100,000 parts of water.

NEW HAMPSHIRE COLLEGE

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AGRICULTURE AND THE MECHANIC ARTS

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BULLETINS OF 1898

Bulletin 49—Inspection of Fertilizers. January.
Bulletin 50—Dehorning Cattle. February.
Bulletin 51—Sweet Corn in New Hampshire. March.
Bulletin 52—Growing Muskmelons in the North. April.
Bulletin 53—The Farm Water Supply. May.

THE FARM WATER SUPPLY

BY FRED W. MORSE

Since the experiment station has been in its present location, it has often been asked to analyze water, and numerous samples from wells and springs have consequently been examined to find out their sanitary condition.[1]

This bulletin has been prepared in order to present to the farmers of the state some facts observed in the course of the work that should be of interest to the occupants of every farm, especially in those sections of the state which attract summer visitors.

New Hampshire has been provided by Nature with an abundant and pure supply of water. The springs and streams of the state that are beyond the reach of the wastes from its population, furnish water which is almost always pure and soft, because most of our rocks are made up of the minerals, quartz, feldspar, mica and hornblende, which dissolve very slowly, even in the strong acids of the chemical laboratory. Limestone, which is more easily dissolved, and is usually the cause of "hard" water, occurs in only a few localities along the Connecticut river. According to Professor Hitchcock,[2] the limestone area includes portions of Stewartstown and Colebrook; isolated ridges in Littleton, Lisbon, Lyman, Orford and Lyme; most of the townships of Plainfield and Cornish, a strip through Claremont and a hill in Charlestown.

The source of the water which flows in streams, lies quietly in lakes, bubbles forth in springs or stands in wells, is the rain and snow. Part of the rainfall on any area, runs off the sloping surface to the brooks and ponds, some is evaporated by the wind and sun, and the rest soaks into the soil, which at some distance below the surface is thoroughly saturated. The upper level of the standing ground water is commonly called the water-table, and is somewhat higher than the surface of nearby ponds or quiet streams, the height varying with the shape of the land, the kind of soil, and the dryness of the season.

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[1] At first the work was done free of charge; but as it has increased and required a large amount of time on the part of the chemical laboratory, while the government appropriation was not intended for such sanitary investigations, it has become necessary *to charge a fee sufficient to cover the cost to the station for time and material.*

[2] Geology of New Hampshire.

The proportion of matter, which the ground water will have in solution, depends upon the quantity of soluble substances with which it came in contact during its passage from the clouds, through the air and soil, and the amount of dissolved material that plant-roots will absorb as the water percolates among them.

This soluble matter consists of both organic and mineral substances and is determined by evaporating a measured quantity of water to absolute dryness and weighing the residue. In waters from localities affording no opportunity for pollution from dwellings or barn-yards, we have found less than 10 parts of solid residue from 100,000 parts of water, while in waters from polluted sources we have almost always found a much larger amount. By carefully burning the total residue, the organic matter is destroyed and the mineral matter determined by weighing the fixed residue. Following are some results which substantiate what has been said about the naturally insoluble nature of New Hampshire rocks:

RESIDUES FROM UNPOLLUTED GROUND WATERS. PARTS IN 100,000

LOCALITY.	Total solid residue.	Fixed residue.	LOCALITY.	Total solid residue.	Fixed residue.
Durham..........	8.20	5.40	Hillsborough ..	6.20	4.40
Durham.....	9.80	4.80	Meredith.......	5.60	4.20
Durham....	9.40	....	Wakefield......	4.20	2.20
Newmarket......	5.80	2.90	Tamworth......	5.00	3.20
Northwood	6.80	....	Ashland.........	4.40	....

Similar results have been obtained in Massachusetts. According to the Report of the Massachusetts State Board of Health for 1891, page 356, twenty-two unpolluted springs yielded water with less than ten parts of solid matter dissolved in 100,000 parts of water.

More important than the amount of matter dissolved in the water, is the composition of that matter, a study of which is necessary in order to judge the source of the substances in solution and whether a water is dangerous or not. The best evidence of the origin of the matter dissolved in water, is obtained by determining the amount of chlorine present. This element is one of the two that form common salt and is almost invariably present in a natural ground water; but in only slight traces, except near the sea-coast where the spray from the ocean is taken up bodily by the wind and borne inland. The proximity of cultivated fields must modify the amount of chlorine naturally present in a spring-water, owing to the application of fertilizers.

The lowest results obtained in waters from apparently unpolluted springs are given in the table. It will be noticed that the figures decrease rapidly as the distances of the localities from the coast increase. These figures are similar to those obtained in Massachusetts from normal waters.[1]

CHLORINE IN UNPOLLUTED GROUND WATERS. PARTS IN 100,000.

LOCALITY.	Chlorine.	LOCALITY.	Chlorine.
Durham, Strafford Co........	0.63	Northwood, Rocki'gh'm Co	0.20
Durham, Strafford Co........	0.53	Epsom, Merrimack Co.....	0.21
Durham, Strafford Co........	0.41	Alexandria, Grafton Co...	0.14
Newmarket, Rockingh'm Co	0.49	Lempster, Sullivan Co.....	0.11
Barrington, Strafford Co....	0.39	Tamworth, Carroll Co......	0.10

To judge the healthfulness of a water after knowing something about the origin of its soluble constituents, the most stress is laid upon the relative quantities of four different compounds of nitrogen, an element occurring in all animal and vegetable tissues, as well as forming four-fifths of the atmosphere. It occurs in water in the form of ammonia, soluble organic matter and two classes of compounds, called respectively nitrites and nitrates.

The ammonia in unpolluted spring-water is due mainly to the rain, which washes the atmosphere free of this gaseous substance, that escapes into it from every fire and every piece of decaying animal or vegetable substance. The ammonia present in water is usually spoken of as free ammonia in order to distinguish it from ammonia which the chemist obtains from the nitrogen in the soluble organic matter by means of suitable chemicals and calls albuminoid ammonia. Ammonia and soluble organic matter containing nitrogen are rapidly changed in the soil by certain micro-organisms into nitrites and nitrates. These latter compounds, especially nitrites, are also formed in the atmosphere by electrical discharges and therefore occur in rain especially after or during thunder showers. Nitrites and nitrates are very necessary to the life of plants, however, and consequently, under natural conditions of soil and moisture, they will be absorbed by plant-roots as fast as formed. Hence unpolluted springs show no nitrites nor nitrates and only minute quantities of free and albuminoid ammonia. Heavily manured fields in the vicinity of a spring may cause the presence of nitrates and nitrites as well as an increase of chlorine in the water, because there is often a larger supply of them than the crops can handle, and they are easily leached from the upper layers of soil beyond the reach of plant-roots. Leaves or sawdust not uncommonly to be found in springs, are pretty sure to increase the amount of albuminoid ammonia above what it would be if the spring were clean. The following table will better explain these variations.

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[1] Rept. Mass. State Board of Health, 1890.

NITROGENOUS MATTER IN GOOD GROUND WATERS. PARTS IN 100,000.

Locality.	Free Ammonia.	Albuminoid Ammonia.	Chlorine	Nitrogen in Nitrites.	Nitrogen in Nitrates.	Solid Residue.
Fremont[1]........	.0014	.0032	.34	.0000	.000	5.40
Durham[2].........	.0028	.0065	.68	.0004	.025	*15.00
Northwood[3]......	.0005	.0158	.20	.0000	.000	6.80

* Walls of spring are of brick and cement, causing lime in water and high solid residue.

[1] Free from contamination. Residue did not blacken when burned.

[2] Spring near a corn-field. College farm.

[3] Spring contained leaves. Residue blackened when burned, showing presence of organic matter.

Water from very deep wells which get their supply from strata of soil below the influence of local surface impurities, usually differ somewhat in composition from the waters of unpolluted springs, more particularly in the amounts of mineral matter and chlorine. In the table which includes a few such wells, it will be noticed that the solid residue is much higher in proportion, than it is in the spring-waters; yet the insolubility of our granite rocks is still manifest, because similar depths in other parts of our country yield water containing from four to ten times as much soluble mineral matter.

CONSTITUENTS OF WATERS FROM DEEP WELLS. PARTS IN 100,000.

LOCALITY.	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen in Nitrites.	Nitrogen in Nitrates.	Solid Residue.
Newmarket[4]	.0012	.0024	5.12	.0002	....	22.5*
Newmarket[5]	.0005	.0005	0.59	.0000	....	16.2
Dover[6]	.0028	.0080	0.67	.0000	.035	19.4*
Farmington[7]	.0094	.0024	0.62	.0000	.001	12.2†

* Solid residue contained much lime.

† Solid residue contained much iron. Water was opalescent with iron compounds.

[4] Well dug through 5 feet of sand, then through 28 feet of soft clay. Thence an iron pipe driven down 59 feet, finally striking a thin layer of gravel over solid rock. Bottom of pipe reaches a depth 15 feet below the bed of the river, which at high tide runs within 50 feet of the well. Well overflows continuously at a level 5 feet above high tide.

[5] Well 108 feet in depth, first 30 feet in sand, then 68 feet in clay, remainder in gravel. Water rises to within 10 feet of surface of ground.

[6] Well 170 feet in depth, drilled down from the bottom of an old well through 140 feet of rock.

[7] Well 128 feet in depth, drilled in a ledge.

A few samples of water have been received that were seriously contaminated with iron, though otherwise good. Such water is usually clear when freshly drawn from the well, but on exposure to the air, it soon becomes opalescent, due to the changes taking place in the iron salts by which insoluble compounds are formed, sometimes ending in deposits of particles of iron rust. Such water is more unpleasant than injurious, being especially unsuitable for laundry use. The iron may, and usually does, come from iron salts in the rocks; but in one case it appeared to be due to an old chain-pump. The former cases cannot be remedied, but the latter could be.

Having been provided by nature with the best of ground water, what kind does the average farm household use for drinking and other domestic purposes? An examination of many farms will show that the well has been located with more regard for convenience than health. A common situation is within fifty feet of a sink-drain, a privy-vault, or a barn-yard, and sometimes the well is surrounded by all three. Usually a curb or embankment prevents any surface-wash from entering the well; but it does not appear to be borne in mind that a large part of the rain-fall soaks into the earth, carrying with it the soluble constituents of animal and kitchen wastes with which it came in contact on the surface, sooner or later to reach the well.

The waters from such wells have almost always been found to leave much larger amounts of solid residue than those from unpolluted springs, and contain a higher proportion of chlorine, because salt is abundant in all animal excretions and kitchen slops. The waters are usually hard, since lime is also an important constituent of animal wastes. High chlorine at a distance from the ocean, may be considered in this state, a sure indication of sewage pollution, and in most sections hard water should be regarded with suspicion. The four forms of nitrogen compounds in these waters give a larger aggregate than in pure spring-waters, but the relative proportions of free ammonia, albuminoid ammonia, nitrites and nitrates, vary widely in different samples. They all come from animal and vegetable matter dissolved in the water, and show the stages of decomposition which such matter has reached. These stages depend upon the character of the soil and the amount of contamination.

Free and albuminoid ammonias are usually high where the soil either permits free pollution or hinders the oxidation of the organic matter. Nitrates are high when the soil favors the rapid oxidation of the organic matter. Consequently, waters containing much free and albuminoid ammonia arising from sewage, would be dangerous; but if the nitrogen were present only in the form of nitrates, the sewage would have been oxidized to harmless mineral matter. Nitrites being an intermediate stage in the destruction of organic matter are looked upon as suspicious constituents of water if not dangerous.

The table shows the results obtained in the examination of some typical farm wells, selected from the large number of analyses made during the past five years. The last three numbers are the only ones of their class from which samples have been received; but they show clearly what can be accomplished by intelligent care of the well's surroundings.

CONSTITUENTS OF WATERS FROM FARM WELLS. PARTS IN 100,000.

LOCALITY.	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen in Nitrites.	Nitrogen in Nitrates.	Solid Residue.	Remarks.
Dover[8]	.0018	.0204	5.08	.0260	.714	37.00	Bad.
Northwood[9]	.0192	.0152	7.[illegible]8	.0005	.060	47.80	Bad.
Weare[10]	.2000	.0344	6.22	.0570	2 000	53.40	Bad.
Lee[11]	.0082	.0206	1.20	.0150	.060	10.00	Bad.
Durham[12]	.0024	.0104	2.60	.0000	.000	21.80	Suspicious.
Milford[13]	.0052	.0090	4.08	.0008	.001	18.00	Suspicious.
Raymond[14]	.0052	.0034	4.10	.0016	.400	23.20	Suspicious.
Alstead[15]	.0000	.0038	7.00	.0012	2 250	49.20	Thoroughly oxidized.
Peterborough[16].	.0025	.0115	.68	.0000	.400	8.00	Probably safe.
Milford[17]	.0014	.0028	.84	.0000	.000	9.40	Good.

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[8] Well situated near the door of house. Curb of well and embankment to cellar are higher than surrounding ground. Water pumped from well to clear the pipe stands in hollow between curb and embankment until it soaks into ground or evaporates. Much of this water probably again reaches the well.

[9] Well, 13 feet in depth, 80 feet to privy vault, 80 feet to sink-drain, 70 feet to barn-yard. Soil, a gravelly loam, overlying gravel, blue hard-pan, sand and ledge.

[10] Well, 18 feet in depth, 50 feet to barn-yard.

[11] Well, 15 feet in depth, 45 feet to barn-cellar, 75 feet to sink drain.

[12] Well, 20 feet in depth, 60 feet to vault, 40 feet to sink drain, 60 feet to barnyard. Soil, a stiff clay.

[13] Well, 20 feet in depth, 50 feet to vault, 30 feet to sink drain, 50 feet to barnyard.

[14] Well, 14 feet in depth, 60 feet to vault, 60 feet to sink drain, 75 feet to barnyard containing a pool of liquid manure. Soil, a gravelly loam with sandy subsoil.

[15] Well, 24 feet in depth, formerly within 60 feet of vault, 30 feet of sink drain, and 100 feet of barn-yard. All these surroundings have now been removed and the ground scraped clean. The analysis shows a heavy contamination in the past; but now thoroughly transformed into harmless mineral salts.

[16] Well, 20 feet in depth, situated between house and shed. Sink drain and vault have been removed from proximity to well.

[17] Well, 10 feet in depth, 56 feet to vault, which is water-tight; 100 feet to sink drain, which flows over surface of ground; 16 feet from corner of barn-cellar, which is cemented on the bottom and kept dry. A good example of thorough care.

The question may be asked, What is the specific effect on the human system of these substances which occur in drinking water? It is the opinion of several physicians interrogated, that many cases of general debility and of bowel troubles may be ascribed to water polluted by sewage. The latter complaints are especially apt to occur in individuals who are newly subjected to such water, after being accustomed to good soft water. This fact makes especially emphatic the necessity of pure water on farms that accommodate summer visitors from the cities.

The greatest danger in the use of sewage polluted water, is the possible presence of the bacteria which cause typhoid fever. These germs of disease cannot exist for any length of time in our good spring waters, because there is too little matter for them to feed on; but polluted waters furnish the necessary conditions for their maintenance in the products of decomposing organic matter, and they may live in such water several weeks, ready to poison some person obliged to drink it.

Of course, all waters showing high proportions of chlorine and ammonia do not contain disease germs; but the figures are danger-signals not to be disregarded.

It is commonly assumed that the soil acts as a filter on water and removes all dangerous matter as the water passes through it, but repeated trials by sanitary experts have shown that neither earth nor any other common filtering material will remove disease germs from water unless there is a thorough destruction of the soluble organic matter, thus depriving them of food.

To make more emphatic the dangerous character of typhoid-fever germs, a few facts are given from the Report of the Massachusetts State Board of Health for 1892, and from Mason's *Water Supply*.

Typhoid fever is produced by a bacillus that is invariably found in the feces of victims of the disease. This bacillus has been found to live three weeks in river water, three months in the stools of a typhoid patient, over three months in ice, and five and one half months in soil. Sunlight will kill the germs; but the sun's rays do not penetrate the earth nor into the recesses of privy-vaults and cess-pools.

In many instances, reasonable care of the surroundings of the well would remove all danger from disease by the pollution of the water. Privy-vaults should be made water-tight, well ventilated, and frequently supplied with dry earth. Nature has provided an abundance of micro-organisms in feces and in soil that with plenty of air and little moisture will rapidly change all soluble organic matter into harmless gases to be dissipated in the atmosphere. The sink-drain should be carried as far as practicable from the house to a lower level than the bottom of the well if possible, and discharged upon the surface of the ground. The sun will help disinfect the sewage and if rank plants are encouraged to grow on the spot during the summer, there will be little percolation to the ground-water.

A cess-pool should never be used in the vicinity of any well or spring; a pit in the earth, from which the water, saturated with soluble filth, slowly seeps away, furnishes practically no chance for the purification by the soil organisms, because they act weakly or not at all, at depths of two to three yards below the surface of the earth.

The economical handling of manure and garbage by composting in cemented cellars or sheds, where leachings cannot escape, will prove both pecuniarily and healthfully superior to the careless treatment usually given those substances.

On many farms a supply of water can be obtained from a source remote from any danger of contamination, and the substitution of such a source for the farm-well is the best means of receiving good water. When a spring is lower than the farm-buildings, careful attention should be paid to the direction in which the drainage from them would naturally flow. A pond or stream is seldom suitable for a family supply because its drainage-basin is usually beyond the control of any single farm. A tight cistern connected with clean roofs furnishes a safe source of supply if the cistern is kept clean.

For more details of the disposal of sewage on the farm and the care of a water supply, the reader is referred to *Farmers' Bulletin, No. 43, Sewage Disposal on the Farm*, which may be obtained by addressing the Secretary of Agriculture, Washington, D. C.

Bulletin 54 **June 1898**

NEW HAMPSHIRE COLLEGE
AGRICULTURAL EXPERIMENT STATION

THE WINTER FOOD OF THE CHICKADEE

The Chickadee or Black-Capped Titmouse.

BY CLARENCE M. WEED

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS

DURHAM

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The Bulletins of this Station are sent free to any resident of New Hampshire upon application.

THE WINTER FOOD OF THE CHICKADEE

BY CLARENCE M. WEED

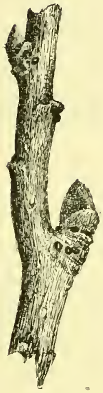

FIG. 1. Eggs of Apple Aphis.

Throughout New England, the Chickadee, or Black Capped Tit-mouse, *Parus atricapillus*, is one of the most abundant winter birds. It is commonly distributed over a wide area, in which it may be seen day after day, busily searching the twigs and branches of trees and shrubs. In order to determine more definitely the economic status of the species, the writer recently undertook a study of its winter food, the results of which are recorded in this bulletin. In the investigations I have been indebted to Mr. Ned Dearborn for many specimens, and have been aided in various ways by my assistant, Mr. W. F. Fiske. I am also under obligations to Dr. L. O. Howard of the U. S. Department of Agriculture, for the determination of some of the food elements.

The results as a whole show that more than half of the food of the chickadee during the winter months consists of insects, a very large proportion of these being taken in the form of eggs. About five per cent. of the stomach contents consisted of spiders or their eggs. Vegetation of various sorts made up a little less than a quarter of the food, two-thirds of which, however, consisted of buds and bud scales that were believed to have been accidentally introduced along with plant-lice eggs. These eggs made up more than one-fifth of the entire food, and formed the most remarkable element of the bill of fare. It seems to me evident that a large proportion of the bud scales are accidentally introduced into the stomachs of the birds, because most of the aphid eggs are taken from the crevices beside the buds of deciduous trees and shrubs, and so it must commonly happen that bud scales are pecked away and swallowed with the eggs.

This destruction of the myriad eggs of plant-lice which infest fruit, shade, and forest trees is probably the most important service which the chickadee renders during its winter residence. As indicated in the record below, more than 450 eggs sometimes occur as the food of one bird in a single day. On the supposition that one hundred were eaten daily by each of a flock of ten chickadees, there would be destroyed 1,000 a day, or 100,000 during the days of winter, a number which I believe to be far below the real condition, could we determine it precisely.

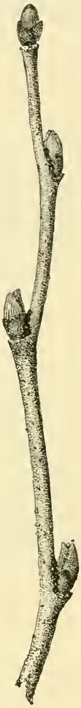

FIG. 2. Plant Lice Eggs on Twig of Birch (These eggs are eaten by Chickadees.)

The most remarkable fact regarding the life history of plant-lice is their power of multiplication. Each egg hatches in spring into what is known as a viviparous female aphid, that is, a form which gives birth to living young by a process similar to the method of reproduction in some of the lowest animals, known as budding. This process begins about two weeks after hatching, each aphid giving birth to a large number of young, that in turn soon become mature and give birth to others. Consequently multiplication goes on in a constantly increasing geometrical ratio, that leads to the production of enormous numbers of the pests. Were it not for the numerous checks upon these insects found under natural conditions, they would overrun plants everywhere and render agriculture futile. In the window-garden and the greenhouse, where these checks are not always at work, the aphides often destroy plants unless some artificial remedy is employed against them. Even on crops out of doors the injury due to their presence is frequently great, and were it not for the destruction of their eggs by chickadees and other enemies, there can be no doubt that the damage would be vastly greater.

On those trees whose leaves drop off in autumn the eggs of plant-lice are commonly deposited in the crevices about the buds. The eggs of the common apple aphis are indicated as black specks about the buds in Fig. 1; those of an abundant species on birch are shown in Fig. 2; while Fig. 3 illustrates the eggs of a species that lays its eggs in great numbers upon the bark of willow branches. Although it is impossible to determine precisely the different species of plant-lice from their eggs, there was reason to believe that each of the species shown in these three figures had been eaten freely by the chickadees examined.

Insect eggs of many other kinds were found in the food of the chickadees. Many of these it was impossible to recognize, but there was no difficulty in identifying the eggs of the common American Tent Caterpillar,[1] the egg mass of which is illustrated in Fig. 4, and of the Fall Canker Worm,[2] the eggs of which as found upon elm are represented in Fig. 5. There were also present the eggs and egg sacs of many spiders of kinds commonly occurring under loose bark (Fig. 6). While spiders as a class are doubtless beneficial creatures, the destruction of some of them is not in my opinion seriously detrimental to the usefulness of the chickadee.

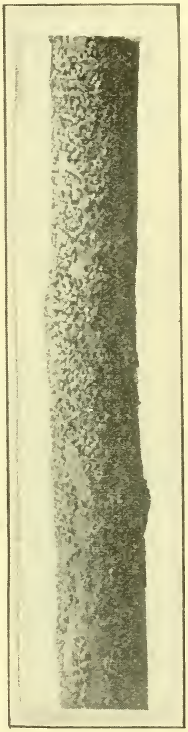

Fig. 3. Eggs of Plant-lice on Bark of Willow. (From a Photograph.)

The larvæ of several different kinds of moths were also found. One of the most abundant species was believed to be the common apple worm, the larva of the codling moth (Fig. 7). It was difficult to be sure of the species, because the heads of the larvæ were nearly always absent, but there is little doubt

[1] *Clisiocampa Americana.*

[2] *Anisopteryx pometaria.*

as to its identity. Another larva commonly found was one which winters over on the twigs in a small silken case, as shown in the light spots in Fig. 8. The bark beetles of the family *Scolytidæ*, which are destructive to forests all over our country, were also freely eaten by the chickadees. Some birds which had passed through the pine woods of the College farm were found to have eaten many of these beetles, the precise species being determined by Mr. E. A. Swarz of the United States Department of Agriculture, as *Pityogenes sparsus* Lec. So much of the time of these birds is spent in the woods that it is evident that they are of great benefit in destroying bark-beetles and other pests of forest trees.

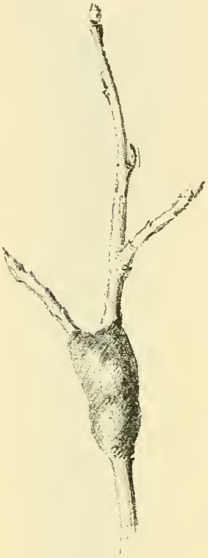

Fig. 4. Egg-mass of American Tent Caterpillar. (These eggs are eaten by Chickadees.)

The hairy skins of the fruit of the common wild sumachs were among the most abundant elements of the vegetable food present. The edible portion of these fruits is evidently eaten to a considerable extent throughout the winter.

The Results in Detail

On the assumption that the scientific details of this study of the chickadee's food will not be of especial interest to the general reader, the following records are printed in smaller type, and may be passed over by any one who cares only for the general results.

But one specimen taken in November (the 12th) was studied. It had been killed after a tour through the tops of the pines in the College woods, and the stomach was chiefly filled with the fragments of small beetles belonging to the family of bark beetles *(Scolytidæ)*. These were estimated to form 85 per cent. of the entire contents. There were also five large eggs of an insect which were identified by

Dr. L. O. Howard as belonging to some species of the family *Reduviidæ*, making 2 per cent.; three small larvæ, apparently of the order Diptera, 1 per cent.; fragments of sumach berries, 2 per cent., and undetermined material, 10 per cent.

The next specimen was taken December 9th in an apple tree, it having previously been followed through a mixed growth of young pines, maple, willow, and birches. The stomach was nearly full of the eggs of aphides, 429 of these being counted in the mass; they were estimated to form 70 per cent. of the stomach contents. There were also present a small moth, 4 per cent.; a Carabid beetle, 5 per cent.; a snout beetle, 4 per cent.; two insect larvæ, 4 per cent.; an egg of the fall canker worm, 1 per cent.; feathers a trace, and undetermined material, 1 per cent.

The first specimens collected in January were taken on the 19th at 2 p. m., and consisted of four birds which had just passed through a young growth of grey birches, apple and maple trees growing in a neglected pasture. Three of these had eaten largely of vegetable matter which was doubtfully identified as the buds of some small plant; this material constituted 70 per cent. in two of the specimens and 75 per cent. in the third. The first bird had eaten in addition the following: Three insect larvæ, 1 per cent.; about 45 insect eggs, 5 per cent.; undetermined insects, 2 per cent.; small seeds, 6 per cent.; undetermined material, 8 per cent. The second specimen had a somewhat similar record, except that 6 per cent. of aphid eggs had been eaten. The third had eaten a large geometrid larva, forming 5 per cent of the food. The fourth chickadee of this lot had partaken of a somewhat different food from the other three. The principal item in its bill of fare consisted of material which was believed to be the skins of apples hanging from the trees, making 40 per cent. of the total food; plant-lice eggs formed 6 per cent.; eggs of fall canker worm, 4 per cent.; a lepidopterous larva, 10 per cent.; a large bud of a deciduous tree or shrub, 8 per cent.; small buds, 6 per cent.; and material not determined, 26 per cent.

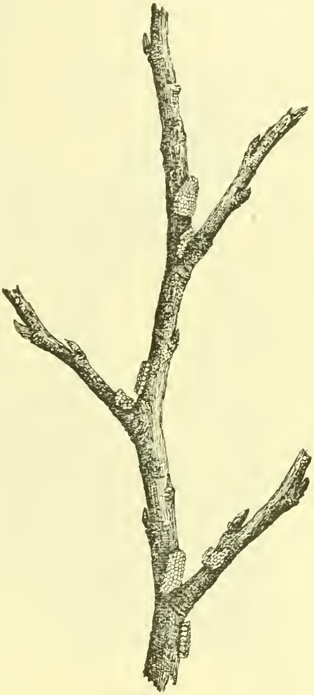

Fig. 5. Eggs of Fall Canker Worm on Elm Twig. (Chickadees feed freely on these Eggs.)

Two chickadees were taken in Durham among some grey birches on the banks of the Oyster River at 10 A. M., February 14th. Both had eaten largely of the small bud-like materials already noted, making 58 per cent. of the food in one and 37 per cent. in the other case. The other food elements of the first were aphid eggs, 24 per cent. ; undetermined insects or their allies, 4 per cent., and undetermined material, 14 per cent. The stomach of the second specimen contained very little food, a caterpillar making 33 per cent., undetermined insects 8 per cent., grit 5 per cent., spiders 4 per cent., and undetermined material 13 per cent.

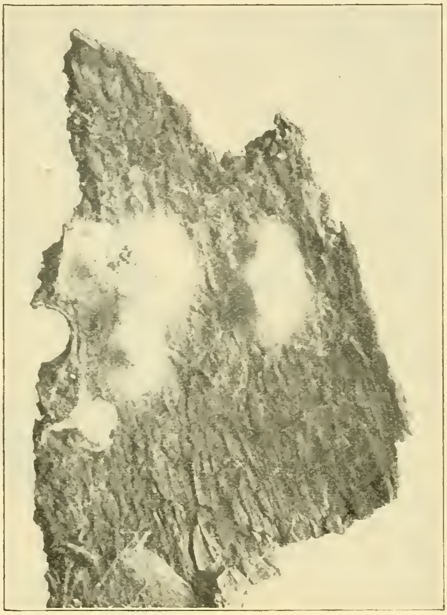

Fig. 6. Egg-sacs of Spiders on loose bark.

Four chickadees taken February 17th while feeding in a mixed growth of birch and pine had eaten chiefly aphid eggs, these constituting 62 per cent. of the entire food of the first specimen, 52 of the second, 46 of the third, and 61 of the fourth. In addition, one bird had eaten the eggs of the common American tent caterpillar to the extent of 16 per cent., and another had eaten a few specimens of a small flea beetle known to science as *Prasocuris varipes*. (Fig. 9.) The other food elements were certain small round bodies of unknown origin, eggs of insects, bud scales, and seeds of birch.

Another chickadee feeding in an apple tree February 17th had eaten 60 per cent. of the skins of sumach berries, 28 per cent. of aphid eggs, 3 per cent. of the eggs of bugs of the family *Reduviidæ*, and 2 per cent. of bud scales, while 7 per cent. was not determined. Still another killed on the same day in a clump of small pine trees had taken aphid eggs 19 per cent., bud scales 49 per cent., feathers 1 per cent., a spider, 2 per cent., and undetermined material 29 per cent.

Fig. 7. The Codling Moth.

Three chickadees were shot in an apple orchard February 19th, at 3 : 30 p. m. Their food was estimated as follows :

No. 1. Eggs of aphids, .05; cocoon and larvæ of codling moth (?), .15; spider eggs and egg sac, .28; undetermined insects, .11; undetermined vegetable matter, .18; undetermined animal matter, .22; grit, .01.

No. 2. Five codling moth larvæ (?) .67; cocoon of codling moth (?) .07; eggs of aphids, .12; small beetle *(Hoplocephala bicornis?)* .01; eggs of insect. .01; eggs of spiders, .01; spider, .02; buds, .05; undetermined material, .04; feathers, trace.

No. 3. Eggs of aphids, .52; lepidopterous larvæ, .28; two spiders and web, .10; bud scales, .03; undetermined, .07.

The next specimen was killed at 3 p. m. February 18th while picking at a small twig of a birch tree. It had evidently been eating the eggs of the plant-lice that are so abundant beside the buds of the birch, as 74 per cent. of the food consisted of aphid eggs, of which two sizes were present;—the smaller were probably those of the birch species. In addition there was a caterpillar, making 4 per cent.; small cocoons apparently of hymenopterous insects, 2 per cent.; bud scales, 9 per cent.; undetermined insects, 2 per cent.; and other material, 9 per cent.

Another chickadee taken at the same time in a similar situation contained 52 per cent. of aphid eggs and various other materials.

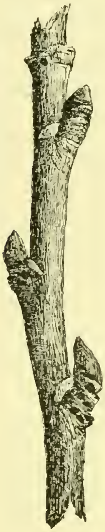

Fig. 8.—Winter cases of a small caterpillar beside apple buds. (They show as light spots.)

Two chickadees were taken at 4 p. m. February 26th at Durham Point in a mixed growth of pines and birches. One of these had eaten 454 eggs of aphides, making 44 per cent. of the food, and an equal percentage of material that seemed to be the dried castings from the old nests of tent caterpillars. In addition there were feathers, spiders' eggs, canker worm eggs, and woody matter, each estimated at 1 per cent., as well as 8 per cent. of undetermined material. The other bird contained the following: A good-sized fly, 11 per cent.; nine spiders—one large, one medium, seven small—24 per cent.; two spider egg-sacs, 10 per cent.; canker worm eggs, 2 per cent.; a measuring worm (*Geometridæ*), 22 per cent.; feathers, 1 per cent.; and undetermined material, 30 per cent.

Three chickadees were shot on March 4th at about 11:30 a. m. They belonged to a large flock which had been flying from tree to tree through the woods. The first had eaten 42 per cent. of aphid eggs, 18 per cent. of buds and bud scales, 9 per cent. spider and web, 2 per cent. of beetles, 6 per cent. of sumach fruits, 2 per cent. of oval brown insect eggs, and 21 per cent. was undetermined. The second specimen had eaten a large spider making 37 per cent. of the whole, and some spider's web making 7 per cent. more; leaf-hoppers of the family *Jassidæ*, 4 per cent.; eggs of fall canker worm, 4 per cent.;

Fig. 9—Flea beetle, magnified (Eaten by chickadee.)

a moth and pupa, 12 per cent.; the winter cases of a tineid, 3 per cent.; sumach berries 7, and undetermined material, 26 per cent. The third specimen was remarkable for the number of insect eggs which it had eaten. There were 121 good-sized eggs of aphides and 147 small eggs of aphides, the two together making 52 per cent. of the total food; in addition there were 20 reduviid eggs, making 9 per cent.; 15 round black and white eggs with a recticulate surface, 9 per cent.; and 15 oval, pointed, white eggs, making 5 per cent. Spiders and their cases made 6 per cent.; a lepidopterous larva, 3 per cent.; a beetle larva, 4 per cent.; a lepidopterous and hymenopterous cocoon, 1 per cent. each; five small larvæ, probably dipterous, 5 per cent.; bud scales, 1 per cent., and undetermined material, 4 per cent.

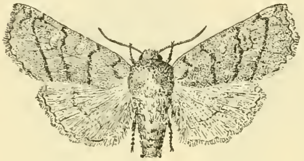

FIG. 10.—Nightflying moth (*Scopelosoma*). Eaten by chickadees

The next specimens studied were three birds taken at 1 p. m. March 4th, in small trees in a pasture. They had been feeding leisurely in trees or shrubs of birch, apple, alder, cedar, and barberry. Two of these had eaten many plant-lice eggs, and many other insects, while a third had eaten a variety of insects.

A chickadee taken about 2 p. m. March 4th in a small lot of pine in a pasture contained the following: Pupa of a lepidopterous insect, 11 per cent.; a lepidopterous larva, 16 per cent.; a spider, 10 per cent.; small hymenopterous cocoons, 24 per cent.; bud scales, 6 per cent.; sumach fruits, 8 per cent., and 25 per cent. was undetermined. About an hour later another bird was shot in a growth of hemlocks. "The circumstances," according to Mr. Fiske's notes, "were quite peculiar, the bird having flown to the ground and being in the act of picking at a piece of dead bark which had fallen from a tree. It was killed instantly, and when picked up had scarcely moved, except to open its wings a little. It had been picking at a nest of spiders' eggs, and the bill was still full of eggs, and in almost the precise position which the bird had assumed in the act of eating." The food record of this specimen was not, however, a very full one: In addition to the spider eggs the bird had swallowed there were aphid eggs 1 per cent.; bud scales, 32 per cent.; sumach fruits, 8 per cent., and 45 per cent. could not be determined.

About 4:30 p. m. March 4th, five chickadees were taken in an open pasture in which were many scattered trees. The birds were busily feeding, and had been noticed on apple, barberry, poplar, hemlock, elm, willow, birch, beech, and oak. The food contents are indicated in the following summaries:

No. 1. Pieces of sumach fruit, .46; eggs of aphides, .11; an insect larva, .21; spider's web, .08; eggs of insects, .04; feather, .01; undetermined arthropods, .04; undetermined material, .05.

No. 2. Stomach very full: aphid eggs, .23; spider eggs and egg-sac, .06; leaf-hopper (*Jassidæ*), .03; insect eggs, .05 (1 per cent. of them thought to be those of the forest tent caterpillar *Clisiocampa* *disstria)*; adult flies (Diptera), .06; puparia of flies, .09; lepidopterous pupæ, .05; insects undetermined, .27; seed of Polygonaceæ, .02; bud scales .01; undetermined material, .13.

No. 3. Stomach full. Eggs of aphides, .35; spider eggs and web, .22; larvæ, believed to be those of the codling moth, .12; other lepidopterous larvæ, .06; undetermined insects, .09; insect larvæ, .03: spider, .04; bud scales, .03; undetermined material, .06.

No. 4. Eggs of American tent caterpillar *(Clisiocampa Americana)*, .06; spider, .16; cocoon of spider, .11; aphid eggs, .04; eggs of fall canker worm, .02; beetles. .03; sumach fruits, .44; bud scales, .08; undetermined material, .06.

No. 5. A large noctuid larva, .44; insect eggs (Reduviidæ?), 19; aphid eggs, .06; insect larvæ, .08; sumach fruits, .07; bud scales, .06; undetermined material, .10.

The next specimen was taken March 11 at 10:30 a. m. in a growth of birch. It contained: aphid eggs, .24; geometrid larva, .12; beetles, .09; hymenopterous cocoons, .12; spiders and their web, .09; lichens, .05; bud scales, .11; and undetermined material, .18.

On March 26th a chickadee was shot at 8:30 a. m. It was one of a flock that was apparently emerging for the first time that day from a small grove thickly set with pine trees. There was very little food in the stomach, all of which appeared to be undigested material from the food of the day before. The only recognizable elements were bud scales, spider's silk and pieces of the legs of insects and spiders.

On March 26th, five chickadees were shot in a sugar orchard, and in apple trees near by. One of them had in its bill when killed the abdomen and part of the wings of the moth represented natural size in Fig. 10 and known to entomologists as *Scopelosoma indirecta*.

The food contents of these specimens were as follows:

No. 1.—Moth, .90 (*Scopelosoma*); eggs, probably from the abdomen of moth, .02; aphid eggs, .02; cocoon of spider, .03; undetermined, .03.

No. 2.—Moth, .27: beetles, .12: spiders, .14; small white egg of an insect, .01; small hymenopterous insect, .01; bark, .12: undetermined vegetable tissue, .26; feathers, .01; undetermined material, .06.

No. 3.—Noctuid moth, .61; bug (*Reduviidæ*), .03: spider, .16; web of spider, 04: undetermined arthropods, .12: undetermined vegetable matter, .04.

No. 4.—Three insect larvæ, probably lepidopterous, .28; small beetles, .05; bark-lice (*Coccidæ*), apparently oyster-shell bark-louse (*Mytilaspis pomorum*), .01; aphid eggs, .01; spider, .06; bud scales, .23; bark, .14; undetermined vegetable matter, .22.

No. 5.—Two lepidopterous larvæ, .38; lepidopterous pupa, .32; dipterous larvæ .14; undetermined adult arthropods, .08; lichen, .01; bud scales, .02; undetermined vegetable matter, .03; feather, .02.

The last specimens of the winter were taken by Mr. Dearborn at 11.00 a. m. on March 29th. They were feeding near the ends of high branches of a large chestnut tree at Northfield, Merrimack Co., New Hampshire. Apparently comparatively little food had been taken that morning, the stomach of the first specimen containing 44 per cent. of bud scales, probably largely left over from the day before, and 30 per cent. of undetermined vegetable matter. In addition there were 9 per cent. of aphid eggs, an equal ratio of adult insects, and 8 per cent. of insect larvæ. The second had eaten even less that morning, there being only a few skins of aphid eggs, and the rest of the material consisting of bud scales and undetermined vegetable matter.

TABLE I.—FOOD OF THE CHICKADEE.

Months.	Nov.		Dec.		Jan.		Feb.		March.		Summary.	
No. of specimens each.	1		1		4		15		20			
KINDS OF FOOD.	No. of spec.	Per cent. of whole.	No. of spec.	Per cent. of whole.	No. of spec.	Per cent. of whole.	No. of spec.	Per cent. of whole.	No. of spec.	Per cent. of whole.	No. of spec.	Per cent. of whole.
Arthropoda (undetermined)							1		3	.01	4	.005
Insecta "					2	.03	5	.02	5	.03	12	.03
Insect eggs "					1		3	.01	7	.02	11	.015
Insect larvæ "			1	.04					6	.04	7	.02
Coleoptera "							1	.01	7	.04	8	.02
Scolytidæ	1	.85									1	.02
Carabidæ			1	.05	1						2	
Tenebrionidæ							1				1	
Chrysomelidæ							1				1	
Curculionidæ			1	.04	1	.01					2	
Larvæ					1		1		3	.03	5	.02
Lepidoptera (undeterm'd)			1	.04	1	.01			4	.10	6	.06
Eggs "					1		3	.01	1	...	5	
Anisopteryx pometaria			1	.01	2	.03	2	.01	2	.01	7	.015
Clisiocampa							1	.01	2	.01	3	.01
Larvæ (undetermined)	1	.01			2	.03	4	.06	8	.06	15	.065
Carpocapsa pomonella?							2	.06	1	.01	3	.025
Pupæ (undetermined)					1		1		6	.02	8	.01
Diptera					1		1	.01	2	.01	4	.01
Larvæ					1				4	.02	5	.01
Puparia									1	.01	1	.005
Hemiptera (undetermi'd)									1		1	
Jassidæ									2	.01	2	.005
Coccidæ									1		1	
Eggs (Reduviidæ)	1	.02					4	.01	2	.01	7	.01
(Aphididæ)			1	.70	3	.05	13	.35	14	12	31	.21
Hymenoptera									1		1	
Cocoons					1		1		3	.02	4	.01
Spiders							5	.03	11	.06	16	.04
Eggs							4	.03	4	.03	8	.025
Vegetable matter (undetermined)							1		5	.04	6	.02
Buds and bud scales					4	.56	9	.10	15	.10	28	.14
Sumach fruit	1	.02					4	.05	7	.07	12	.04
Seeds					2	.03	3	.01	1		6	.01
Lichens									2		2	
Insect excrement (?)					1	.01	5	.09	...		6	.03
Spiders' silk							2	.01	9	.02	11	.01
Undetermined	1	.10	1	.11	4	.24	15	.12	20	.10	41	.11
SUMMARY.												
Insecta		87		88		16		56		58		57.5
Arachnida								6		9		.065
Vegetable matter		.02				.59		.16		.21		.21
Extraneous "		.01		.01		.09		.09		.02		.04
Undetermined matter		.10		.11		.24		.12		.10		.11

ABUNDANCE AND FEEDING HABITS

In order to get some idea of the abundance of chickadees in a region like south-eastern New Hampshire, where a considerable portion of the land is wooded, I requested Mr. Fiske to spend a day in the woods and fields, recording the number of flocks of chickadees seen, the approximate size of each flock, and observing their feeding habits. He has summarized his observations in the following paragraphs :

" In the course of the day, a distance of about seven miles was traversed, without taking into account the many minor deviations in the route ; four square miles would seem a reasonable estimate of the area covered. Eleven flocks of chickadees were seen, varying in numbers from four to forty, but averaging about thirteen in each flock. Estimating the amount of territory covered at four square miles, this would place the number of birds for each square mile at thirty-five, which certainly seems a reasonable estimate.

" During the forenoon, the birds were not very busy feeding, and all the flocks encountered were traveling through the woods at a rate somewhat faster than was pleasant to follow on foot, each bird stopping for an instant at any especially tempting tree or dead stub, and then hastening on to join its companions. In the afternoon, especially toward evening, the birds encountered seemed to be attending much more closely to feeding. Instead of traveling across country, the flock would scatter over a section of woodland or pasture, each bird searching closely the crevices in trees, stumps, and fences. A peculiar habit which I had not before noticed is worthy of mention : when one of the chickadees wished to investigate some crevice or bunch of lichen where it could not obtain a foothold, it would hover before it a moment in the air, as a humming-bird hovers before a flower.

" These remarks apply to a day in early March, which, while not sunny, was still fairly warm and quiet. During the darker days of January and February, when the snow lies deep and the wind is often cold and sharp, the daily life of the chickadee is quite different. Several trips into the field for material for study were made in February, and the birds were then confined more closely to the evergreen woods and other situations equally sheltered, seldom venturing out into open pastures and fields. In the College woods, which are largely composed of tall pines, there was almost always a flock to be found by very little searching, flying from tree to tree far up in the tops, and scrutinizing closely each mossy limb, or alighting on the terminal twigs and picking something out of the leaf clusters. They did not confine themselves to the tall growth by any means, but, in a little clump of trees, very similar to that represented in Figure 11, there was a colony to be found at almost any time during the latter half of February."

ENCOURAGING THE PRESENCE OF CHICKADEES

Fortunately, these useful birds are easily induced to remain upon the premises, where their services, in destroying the insect enemies of orchards, vineyards, and other plantations, will abundantly repay the slight trouble necessary to lead them into a condition of semi-domestication. It has been repeatedly observed by bird lovers in many parts of the Northern states that the chickadees are common in city parks, and about premises in which there are evergreens in which they may find shelter during the storms of winter. Numbers of observers have found that by placing bones with a little meat attached to them in a tree, the chickadees and other winter birds are attracted to it, while in one instance the birds became so tame that they would alight on the person who was studying their habits. Mr. Fiske has had abundant opportunity to study this phase of the subject upon his father's farm in Webster, New Hampshire, and furnishes the following summary of his observations:

"Chickadees may readily be taught to come around the house, if fed regularly, and a flock of them thus partially tamed may be the source of much amusement to one having a liking for birds. They are fond of almost any food of an animal nature, especially if it contain more or less fat; they will also eat farinaceous food to a certain extent, being quite partial to bits of brown bread. If supplied with a surplus of food in the shape of small fragments, they will, after eating all that they can, carry away large quantities and tuck it away in crevices in the bark, or at the base of twigs, in some neighboring tree. If the wood-pile is handy, it affords numerous opportunities for this purpose, and is freely used. This habit of storing food is of great benefit to the blue jays, who, if the food is displayed on a window-shelf, or some similar situation, dare not get it for themselves, but will hang around until it is stored away by the chickadees, when they will steal the morsels from their hiding places."

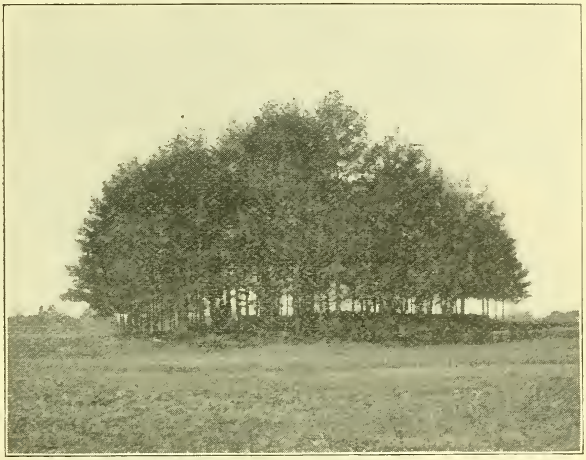

FIG. 11. A Refuge for Birds.

The protection which a pine grove affords to chickadees and other winter birds is one reason why it is desirable to have such a bit of woodland on or near the farm. It also serves as a shelter to many other birds during the summer season.

A remarkable example of the benefit that may be derived from the presence of a flock of chickadees, has been recorded by Mr. E. H. Forbush, in a bulletin of the Massachusetts State Board of Agriculture. In a certain orchard in Massachusetts, canker-worms had been abundant the previous season, and the moths of the fall canker-worm had deposited great numbers of eggs upon the trees. Pieces of meat, bone, or suet were fastened to the trees early in the winter, to attract the chickadees.

The birds came, and remained about the orchard nearly all winter. They were carefully watched, it being found that they were feeding on the eggs of the canker-worm moth. A few birds were killed, to determine the number of eggs eaten. Between 200 and 300 canker-worm eggs were found in the stomach of each of these birds. In the spring, the female moths of the spring canker-worm were also devoured by these birds. The result was that the chickadees, assisted in spring and early summer by various other birds, saved the orchard from any serious injury by the canker-worms.

CONCLUSION

The investigations recorded in this Bulletin, show that the chickadee is one of the best of the farmer's friends, working throughout the winter to subdue the insect enemies of the farm, orchard, and garden. For the efficient service thus rendered the bird asks no pay, although it may be induced to remain more of the time upon the farm premises, if bones or suet are hung in trees where the birds may get it during winter.

The Feeding Habits of the Chipping Sparrow

BY CLARENCE M. WEED

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

DURHAM

Bulletin 55 **July, 1898**

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

DURHAM

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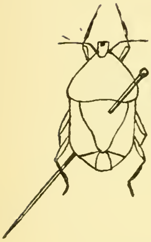
BULLETINS OF 1898.

Bulletin 49—Inspection of Fertilizers. January.
Bulletin 50—Dehorning Cattle. February.
Bulletin 51—Sweet Corn in New Hampshire. March.
Bulletin 52—Growing Muskmelons in the North. April.
Bulletin 53—The Farm Water Supply. May.
Bulletin 54—The Winter Food of the Chickadee. June.
Bulletin 55—Feeding Habits of the Chipping Sparrow. July.

The Bulletins of this Station are sent free to any resident of New Hampshire upon application.

An Observation on the Feeding Habits of the Chipping Sparrow

BY CLARENCE M. WEED



IT is now generally acknowledged that birds are of great importance as checks upon insect life. The studies made by several American investigators upon the food of birds have shown beyond all doubt that these feathered allies of the farmer are essential to successful agriculture.

In the investigations yet recorded there have been comparatively few observations of the precise daily feeding habits of birds under natural conditions. This is necessarily so because of the difficulty of making such observations. In this short bulletin I wish to record a series of observations made during one long day in June (the 22d) by my assistant, Mr. W. F. Fiske, and myself upon a family of chipping sparrows (*Spizella socialis*) that had nested in a small juniper near a window from inside of which they could easily be watched. The nest contained three young sparrows, so nearly full grown that they hopped out of the nest the second day after these records were made.

The observations began at 3 : 40 a.m., somewhat before full daylight. The bird was then on the nest and remained there quietly for ten minutes. From this I judged that the daily task had not yet begun, it being too dark before 3 : 40 for even the early worm to be seen. Between 3 : 50 and 3 : 55 the bird left the nest, returning at 3 : 57 with a small object, apparently a piece of earthworm, in its beak. Three hungry looking mouths were widely opened, into one of which the morsel was dropped; then the bird settled down on the nest and remained two minutes, when it left.

Two minutes later both birds returned and fed the young. One picked up excrement from the nest, flew a few feet away, and immediately returned and sat on the nest. At 4:06 the bird on the nest left (at 4:08 the sun rose) and at 4:09 one bird returned and settled on the nest. At 4:13 it got off the nest and caught an insect of some sort on a branch of the little tree in which the nest was placed, the insect being within a foot of where the bird was sitting. This insect was fed to one young bird and the parent bird flew away. The record for the next hour was as follows:

4:16—One bird returned, fed, flew off with excrement.
4:19—One bird returned with food; settled on nest.
4:25—Bird on nest flew away.
4:30—One bird (thought to be the male) lit in a poplar tree near by, flew from branch to branch, then flew into tree in which nest was, fed one young bird with an insect or worm, then flew away.
4:31—The other parent (believed to be the female) returned, fed, and settled on the nest.
4:34—Bird on nest flew off; the other bird came at once, fed, and flew away.
4:35—A parent (believed to be the female) returned, fed, and flew away.
4:38—One old bird (thought to be the female again) returned, fed, and settled on the nest.
4:41—Bird on the nest left.
4:42—A parent (supposed to be the male) returned, fed, and carried away excrement.
4:56—Old bird (supposed to be the male again) returned with food which was given to one of the young, and carried away excrement.
4:58—Old bird (supposed to be the female) returned, fed one of the young, and settled on the nest a minute before flying away.
4:59—The other bird returned, fed one of the young ones, and cleaned the nest.
5:05—Old bird (thought to be the male) returned, fed nestling, and flew away.
5:07—One parent (probably the mother) returned, fed, brooded a moment, then flew away.
5:10—The same bird (apparently) returned, fed, and flew off.
5:12—Again the old bird believed to be the mother, returned, fed, and then settled on the nest.

The above record will give a fair idea of the activity of these parents during the day. Between 5 and 6 o'clock food was brought fourteen times; between 6 and 7, seven times; 7 and 8, eleven times; 8 and 9, twelve times; 9 and 10, ten times; 10 and 11, seventeen times; 11 and 12, ten times. The afternoon hours were equally well filled. During the first hour (12 to 1) fifteen visits to the nest were made, while the second hour saw twenty-one visits recorded. Between 2 and 3 the parents came twelve times; between 3 and 4, nine times; between 4 and 5, thirteen times; between 5 and 6, nine times; between 6 and 7, ten times. The day's work closed at 7:50, when it was too dark to see the late worm should he still be wandering about.

THE RECORD IN DETAIL

The detailed record of these observations for the remainder of the day is given below in small type. The essential facts of interest to the general reader are summarized in the paragraphs above and at the end of the bulletin:

5:17—The other parent (supposed to be the male) lit in a tree near by; the female flew off, and the bird in the tree came to the nest, fed one of the young, and flew away.
5:20—The female (?) returned fed, and flew away.
5:26—The male (?) returned, fed, and carried away excrement.
5:32—The female (?) returned, fed, and flew off.
5:34—The female (?) returned, fed, and flew off.
5:36—The male (?) returned, fed, and carried away excrement.
5:44—The female (?) returned, fed, and flew away.
5:51—The male (?) returned, fed, and flew away.
5:51.5—The female (?) returned, fed, and flew away.
5:56—The female (?) returned, fed, and flew away.
6:06—The female (?) returned, fed, and carried away excrement.
6:08—The male (?) returned, fed, and flew away.
6:09—The female (?) returned and flew away without feeding the young.
6:17—The female (?) returned, fed, and flew away.
6:28—One parent returned, fed, and flew away.
6:34—One parent returned with a large, green worm; the nestling to which it was given had considerable difficulty in swallowing it.
6:39—One bird returned with some small insect.
6:44—One parent brought a small, dark-colored larva resembling that of a saw-fly.
(A man working a lawn-mower near the nest was probably the cause of this interval of sixteen minutes.)

7 :00—Both birds returned at the same time. The object carried by the male was too small to be identified, while the female had a large, green caterpillar, apparently a noctuid larva. This larva was so large that the nestling could not swallow it without assistance from the parent. When the mother came to the nest, the larva was held in the bill transversely. Before it was given to the nestling the larva was turned around so that it ran lengthwise of the bill.

7 :14—One parent brought a dark-colored caterpillar and carried away excrement.

7 :15—One bird, thought to be the male, has been on a small poplar tree near the nest for the last minute with something in its bill. It has just flown to the tiny cedar shrub near by, then to the tree in which the nest is placed, and back to the poplar at once.

7 :17—The bird in the poplar flew to the nest and fed young. The other parent made a flying visit to the poplar and flew away.

7 :22—One old bird appeared with a large caterpillar, alighting on the poplar a moment before flying to the nest to give it to a nestling.

7 :39—One bird brought a rather large, grey caterpillar and carried away excrement.

7 :44—Both birds returned at once, the male with a large larva, apparently a noctuid (the group to which the cutworms belong).

7 :52—One parent brought a large, greyish caterpillar.

7 :56—One bird, thought to be the male, returned with food and carried away excrement.

7 :58—Parent returned with a worm, fed, carried away excrement.

8 :05—One parent returned with a small insect, fed, and flew away.

8 :09—Parent returned with food, then flew away.

8 :12—One parent returned, fed, and flew away.

8 :17—One parent returned, fed, and flew away.

8 :24—One bird returned to the small poplar tree with a larva, apparently a noctuid, in its mouth. It seemed afraid to go to the nest and remained in the poplar four minutes. Then the other parent returned to the poplar with a worm, looked around a moment, flew to the nest, fed the worm to one of the nestlings, and flew away Meanwhile, the other adult swallowed its worm and flew off without visiting the nest.

8 :39—One old bird visited the tree in which the nest was for a moment and then flew away without feeding the young.

8 :40—Both parents came at once and fed; one, supposed to be the male, carried away excrement.

8: 43—One old bird, apparently the mother, brought a small, dark brown caterpillar, which was fed to a nestling, and carried away excrement.

8 :44—One bird (the male[?]) brought small objects, fed, and flew away.

8:45—The other bird (the female [?]) brought small objects, fed young, and cleaned the nest.

8:47—One parent (the mother [?]) brought a blackish caterpillar and flew away as soon as it was given to a nestling.

8:58—One parent brought a medium-sized, greenish caterpillar.

9:01—One bird (the male [?]) brought some small insect, fed, and flew away.

9:06—The mother (?) brought a large, green caterpillar.

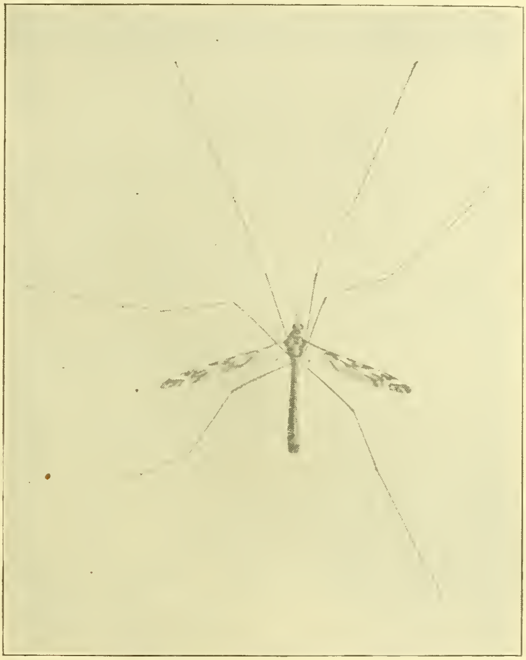


FIG. 1.—A CRANE-FLY (Eaten by Young Chipping Sparrows).

9:07—The male (?) brought some small object.

9:12—The female (?) brought a very large, green caterpillar.

9:13—The male brought some small object.

9:26—One bird brought a large, green caterpillar, large enough to be the larva of *Amphipyra pyramidoides*, and of very much the appearance of that species.

9:38—Both birds returned to the nest at the same time; one had a rather small larva, and the other a large, pale green one. One bird cleaned the nest.

9:39—One bird brought a small, dark caterpillar, and carried away excrement.

9:51—One bird brought a large, green caterpillar, coming through the east side of the tree.

10:13—One bird came to north side of tree with very small object; carried away excrement.

10:16—Bird entered tree by north side with small object which was fed to one of the nestlings. The parent remained for some time looking over the young birds.

10:17—Old bird came through east side with what appeared to be a white grub in its mouth; fed to young and flew away.

10:19—Old bird entered by north side with some small object; waited some moments after feeding the nestling, then settled on the nest and warmed the young.

10:24—One of the parents came through the east side of the tree with a large, green worm; one of the nestlings ate it and immediately opened its mouth for more.

10:25—Other parent entered from north side of tree with small object.

10:28—Bird entered from north side again with small, black insect.

10:30—Bird entered from north side with very small object.

10:34—Bird entered from north side with very small object.

10:38—Both birds came at the same time; as usual, the one that entered by the north side brought a small object, and the other a large, parti-colored caterpillar. The second bird carried away excrement.

10:41—Bird entered from north side with a small object.

10:43—Bird entered from north side with a small object.

10:44—Bird came through the east side with a large caterpillar, believed to be the larva of *Amphipyra pyramidoides*.

10:47—Bird came through north side carrying at least two small objects, one of which was given to one nestling and the other to another.

10:54—Bird entered from north side.

10:59—Bird entered from north side.

11:10—Bird entered from north side.

11:14—Bird entered from north side, carrying a larva supposed to be a *Drepanulid*.

11:20—Bird entered from east side with a large caterpillar.

11:23—One bird came from north side with food.

11:24—Bird came from east side with large caterpillar. (It is noticed that the nestling that is fed opens its mouth the widest immediately afterwards.)

11:30—Bird entered from north side with a small object, and carried away excrement.

11:39—Large caterpillar brought through the east side.

11:40—Small object brought through north side.

11:46—Black caterpillar brought through north side.

11:54—Bird entered from east side with brown caterpillar; carried away excrement.

12:01—Bird entered from east side with brown caterpillar.

12:02—Bird returned and fed young.

12:06—Bird returned and fed young.

12 :10—Bird returned and fed young.
12 :18—Bird returned from north side with a green caterpillar, apparently a cabbage worm.
12 :24—Bird entered from north side with a good-sized insect.
12 :28—Bird entered from north side with a green caterpillar.
12 :36—Parent came from east side with a caterpillar.
12 :37— Young fed by bird entering north side of tree.
12 :38—Young fed by bird entering north side of tree.
12 :41—Young fed by bird entering north side of tree.
12 :44—Young fed by bird entering north side of tree.
12 :48—Bird came through east side of tree with small object.
12 :51—Bird came through north side; carried away excrement.
12 :56—Bird came through east side with a blackish caterpillar.
1 :01—Parent came through north side.
1 :05—Both parents returned at once; one came through north side of tree with small object, and the other by east side with a green, downy caterpillar.
1 :06—One bird brought a brown caterpillar, entering the tree from the north side.
1 :07—Bird brought greenish, black caterpillar through east side of tree.
1 :11—Bird entered north side of tree carrying small object.
1 :13—Bird entered north side of tree carrying small object.
1 :14—Bird entered east side of tree carrying large caterpillar.
1 :16—Bird entered north side of tree.
1 :24—Bird entered north side.
1 :25—Bird entered east side.
1 :26—Bird entered north side.
1 :27—Bird entered north side.
1 :28—Bird entered north side.
1 :30—Bird entered north side.
1 :36—Bird entered north side: carried away excrement.
1 :36.5—Bird entered north side.
1 :37—One bird brought a large caterpillar, coming through east side of tree.
1 :40—Bird entered north side.
1 :51—Bird entered east side.
1 :56—Bird entered east side.
2 :07—Bird entered east side; carried away excrement.
2 :18—Bird entered east side.
2 :28—One parent brought a very large caterpillar, coming in at the east side of tree.
2 :29—Bird entered north side of tree with small objects, which were fed to two nestlings.
2 :33—Bird entered by north side.
2 :39—Both parents came at once, each bringing a good-sized caterpillar.
2 :41—One bird came through north side with a small caterpillar.
2 :45—Bird came through north side.
2 :54—Bird came through east side.

2:58—One parent brought a large crane-fly (Fig. 1), entering the tree on the east side, and carried away excrement.
2:59—Bird fed nestlings, coming from the north side.
3:11—Bird fed nestlings, coming from the north side.
3:15—Bird fed nestlings, coming from the north side.
3:18—Bird fed nestlings, coming from the north side; carried away excrement.
3:26—Both birds came at once, having been searching the lawn near by for a few minutes preceding.
3:28—One bird came to nest, entering north side.
3:29—Bird brought small object through east side.
3:33—Bird came with food from north side.
3:42—Bird came with food from north side.
4:01—Bird came with food from east side.
4:05—Bird came with a caterpillar from north side.
4:09—Bird came with food from north side.
4:13—Bird came with food from east side.
4:16—Bird brought food, entering at east side.
4:24—Bird brought food, entering at north side.
4:38—An exceptionally large caterpillar brought through east side.
4:43—Bird brought food, entering at north side.
4:45—Bird brought food, entering at north side; carried away excrement.
4:45.5—A large caterpillar was brought in at east side; excrement removed.
4:46—Bird brought food, entering at east side.
4:52—Bird brought food, entering at north side.
4:56—Bird brought a caterpillar, entering at north side. Settled on nest to remain four minutes.
5:23—Both birds came at once, one carrying a small object, and the other a caterpillar.
5:25—Bird brought food, entering at north side; carried away excrement.
5:33—Bird brought food, entering at east side; carried away excrement.
5:39—Bird brought food, entering at north side.
5:42—Bird brought food, entering at east side.
5:45—Bird brought food, entering at north side; fed two nestlings.
5:50—Bird brought food, entering at north side.
5:59—Bird brought food, entering at north side; carried away excrement.
6:01—A caterpillar brought in north side; excrement carried away.
6:06—A black insect, apparently a cricket, brought in north side.
6:15—Small objects brought in at north side.
6:17—Small objects brought in at north side.
6:25—A caterpillar brought; excrement carried away.
6:33—Caterpillar brought through east side.
6:34—Food brought through north side.
6:38—Caterpillar brought; excrement carried away.
6:45—Food brought in at north side; excrement carried away.

6:57—Food brought in at north side; excrement carried away.
7:10—Food brought in at north side.
7:16—Food brought in at north side. The sky is clouded, and the atmosphere is now becoming dark.
7:27—Both parents returned; one came through east side, and the other through the north side. One had a large caterpillar, and the other apparently also had one. Both fed and flew away at once.
7:36—One bird came in at north side; fed and flew away at once.
7:49—Now quite dark. One bird flew in, probably the female, got on the nest a moment and then got off and wandered round the tree a minute. Then at 7:50 it settled down on the nest. The young birds poked their heads up for two or three minutes, but the old bird remained quiet, and the young soon withdrew their heads. This was the end of the day's work for the busy parents.

The reason that the side of the tree through which the birds entered was recorded was that it was believed that one of the parents always came through the north side, and the other the east side. But the difference in the sexes is so slight that it was impracticable to be certain of the facts of the case.

SUMMARY AND CONCLUSION

During this busy day the parent birds had made almost two hundred visits to the nest, bringing food nearly every time, though some of the trips seemed to be made to furnish grit for the grinding of the food. There was no long interval when they were not at work, the longest period between visits having been twenty-seven minutes. Soft-bodied caterpillars were the most abundant elements of the food, but crickets and crane-flies (Fig. 1) were also seen, and doubtless a great variety of insects was taken. The precise determination of the most of the food brought was, of course, impossible, the observations having been undertaken especially to learn the regularity of the feeding habits of the adult birds. That they were busy from daylight to dark with no long intermission at any time is shown by the record, and the observation is submitted as a contribution to our knowledge of a subject in which much guessing has been done on account of the lack of definite information.

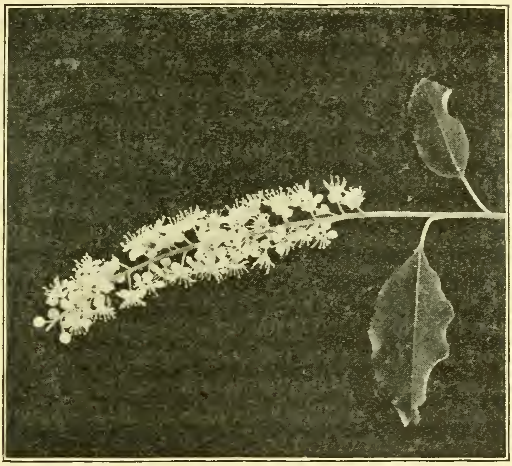
The chipping sparrow is one of the most abundant and familiar of our birds. It seeks its nesting site in the vicinity of houses, and spends most of its time searching for insects in grass lands, or cultivated fields and gardens. In New England two broods are usually reared each season. That the young keep the parents busy catching insects and related creatures for their food is shown by the record on the preceding pages. The bird certainly deserves all the protection and encouragement that can be given it.

Bulletin 56 **August 1898**

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

Poisonous Properties of Wild Cherry Leaves



Flowers of Wild Black Cherry.

BY FRED W. MORSE AND CHARLES D. HOWARD

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

INTRODUCTION

BY FRED W. MORSE

In 1894 and again in 1897 there were received at the Experiment Station, portions of the stomachs of cattle that were supposed to have died of poison in some form. As is apt to be the fact, too small quantities were sent to allow an exhaustive examination. No metallic poisons were found, and therefore from the symptoms preceding death, together with the statements that the animals had had access to wild cherry leaves, in the former case after the shrubs had been mowed and in the latter by browsing, it was thought that prussic acid in the leaves was the cause of death.

Since the different species of wild cherry are numerous beside walls and roads, it was deemed advisable to determine the amount of prussic acid that could be extracted from the leaves and calculate the probable quantity of them, which would be fatal to cows. Mr. Howard was assigned the work of collecting and analyzing specimens, the results of which, reported by him in the following pages, give only a partial idea of the number of analyses made while determining the variations in quantity of acid due to modifications of method (distillation) and those due to different samples of leaves.

PRUSSIC ACID IN WILD CHERRY LEAVES

BY CHARLES D. HOWARD

In order to obtain some definite knowledge—of which hitherto, so far as we can ascertain, there seems to have been none—of the amount of poisonous principle yielded by the different species of cherry leaves, and the conditions, if any, favoring such yield, a somewhat detailed investigation has been made, the work of which extended over portions of the past two summers, including July and the first part of August of each year.

There are five members of the cherry family which occur wild in New Hampshire. To name them as nearly as possible in the order of frequency of occurrence, they are: The Wild Black Cherry (*Prunus serotina*), the Choke Cherry (*Prunus Virginiana*), the Wild Red Cherry (*Prunus Pennsylvanica*), the Wild Yellow or "Horse" Plum (*Prunus Americana*), and the Dwarf Cherry (*Prunus pumila*).

The first two species are of quite common occurrence in all parts of the state; the wild red cherry is very common in the mountainous sections, less so in the southern portion of the state; the wild plum is of rarer occurrence, while the dwarf cherry, according to Hitchcock,* has been found only in the town of Campton.

The leaves of the last named species were not examined, though there would seem to be every reason for considering them dangerous. Investigation showed the leaves of the wild plum, as well as those of the cultivated plum, to be harmless. This is not to be wondered at, as while both species belong to the same general family, they are of a different type from the true cherry.

The least poisonous of the three principal species is the wild

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*Geology of New Hampshire.

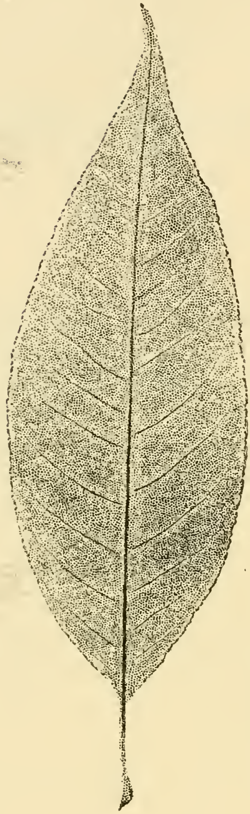


FIG. 1.—Leaf of Wild Red Cherry. Full size.

red cherry, "pigeon cherry," known botanically as *Prunus Pennsylvanica.* This is a shrub, often growing to a small tree, to be recognized by its light, reddish brown bark and waxy, glossy leaves, which are green on both sides, oblong lanceolate in shape, possessing an irregular and sharply serrate edge, the teeth of which are very small and short. (Fig. 1.)

The second species, *Prunus Virginiana*, commonly known as the choke cherry, is more common than the preceding and its leaves are more poisonous. Like the next species, it is to be found as a constituent of the average roadside thicket throughout New England. It is described by Gray as follows:

> "Tall shrub, or small tree, greyish bark, oval-oblong or obovate and abruptly pointed thin leaves, very sharply serrate with slender projecting teeth (Fig, 2.); flowers in shorter and closer racemes (than *P. serotina*) in spring; the fruit ripe in summer, red turning dark crimson, astringent, but eatable when fully ripe."

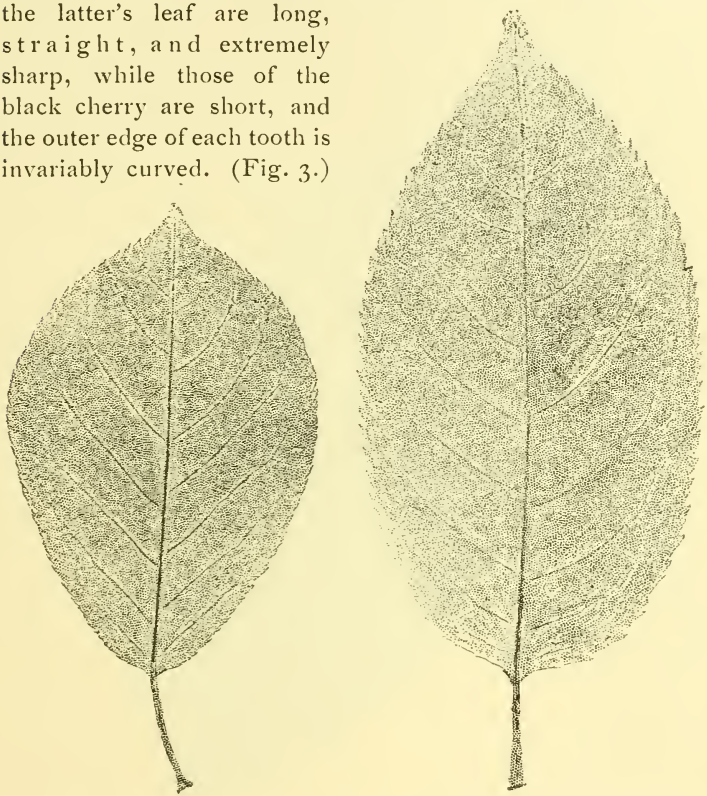
It is a noteworthy fact, serviceable as a means of identification, that this variety is usually more or less affected by black knot, which is never to be found upon the two other species.

By far the most dangerous variety occurring in New England is the wild black cherry, *Prunus serotina*, thus described by Gray:

> "Tree or shrub, westward becoming a good sized forest tree, with bitter aromatic bark, close-grained reddish wood, valued by the cabinet maker; oblong or lance-oblong leaves, thickish or firm texture, usually taper pointed, serrate, with incurved short callous teeth; flowers in

long racemes, considerably later than *Prunus Virginiana;* purplish black, bitterish, vinous fruit ripening in autumn."

The edge of the leaf, especially, is very characteristic, and serves to distinguish it from the choke species. The teeth of the latter's leaf are long, straight, and extremely sharp, while those of the black cherry are short, and the outer edge of each tooth is invariably curved. (Fig. 3.)



a. From full grown shrub. *b.* Common type from young shoots.

FIG. 2.—Leaves of Choke Cherry. Full size.

In this section of the state it is probably the most common of the three species, and when not kept down, is to be found growing beside every wall, where it serves as a favorite base of operations for the tent caterpillar.

The poisonous property of all species of cherry leaves is due to hydrocyanic acid, popularly known as prussic acid. This compound does not exist as such in the growing leaf, but is derived from a class of substances called glucosides, of which amygdalin is the type peculiar to the cherry. This, or a closely allied body, is to be found not only in the leaves and bark, but especially in the stones of cherries, peaches, and plums, and the seeds of the apple. By the action of moisture and a vegetable ferment called *emulsin*, which exists in the

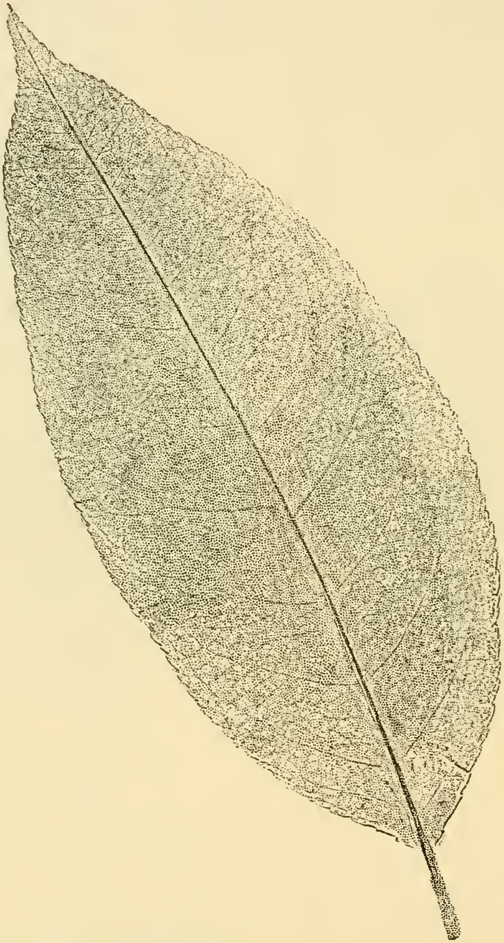


FIG. 3.—Leaf of Wild Black Cherry. Full size.

plant, a complex chemical reaction takes place, that begins in the leaf the moment connection with the circulatory system is cut off. The three products of this reaction are hydrocyanic acid, grape sugar, and benzaldehyde, or bitter almond oil.

There is a popular opinion that the leaves of the cherry are poisonous only when cut and in the wilted condition ; that cattle may safely nibble them from the growing shrub without danger of injury ; and that they are quite harmless when dried. Our observations, however, prove these views to be but partially correct. As a matter of fact, distillations of samples, made within twenty minutes of cutting, show that the freshly cut leaves yield nearly as much acid as the wilted ones do when calculated on the weight of fresh material taken, and when eaten fresh, the character of the juices within the animal stomach is such as to render that organ a most favorable place for the conduct of the reaction in which prussic acid is liberated.

On the other hand, while it is true that the thoroughly dried leaves yield a comparatively small amount of acid, still they may always produce some, and as ordinarily dried in the hayfield, they may be capable of generating a considerable quantity of the poison. The desirability of carefully excluding them from all hay is therefore apparent.

The truth of the preceding statements may perhaps be better comprehended by a study of Table I.

TABLE I.

PRUSSIC ACID FROM ONE HUNDRED GRAMS* FRESH, WILTED, AND DRIED LEAVES.

Wild Red Cherry.			Choke Cherry.			Wild Black Cherry.		
Condition.	Milligrams acid.		Condition.	Milligrams acid.		Condition.	Milligrams acid.	
	Calc. on wt. fresh sub.	Calc. on wt. after drying.		Calc. on wt. fresh sub.	Calc. on wt. after drying.		Calc. on wt. fresh sub.	Calc. on wt. after drying.
Fresh :			Fresh :			Fresh :		
Average of six analyses	91.		Two analyses	139 147		Average eleven analy's	212	
Extremes	81–100					Extremes	193-228	
Wilted :			Wilted :			Wilted :		
To 72 per ct. orig. weig't	103	143	To 75 per ct. orig. weight	176	235	To 83.5 per ct. orig. wt.	205	244
To 66.6 per ct. orig. wt.	91	138	To 65 per ct. orig. weight	159	243	To 78.5 per ct. orig. wt.	232	294
Amount wilted not det.	104					To 78.5 per ct. orig. wt.†	213	271
Amount wilted not det.	94					To 66 per ct. orig. wt.	186	282
Amount wilted not det.	105							
Dried :						Dried :		
To 44 per ct. orig. weig't	37	84				To 42 per ct. orig. wt.	30	71
To 45 per ct. orig. weig't	43	95				To 38.5 per ct. orig. wt.	25	65
Amount dried undet.	24							
Amount dried undet.	25							

*1 gram = 1000 milligrams. 1 gram = 1-31 tr. ounce. 1 gram = 15.4 grains. † See Table II.

A marked difference was found between the quantity of acid obtained from leaves wilted in bright sunlight, and the yield from leaves wilted in darkness, the former condition producing the larger amount.

TABLE II.

COMPARISON OF RESULTS FROM WILTING IN SUNLIGHT AND IN DARKNESS.

CHOKE CHERRY LEAVES. 100 grams.	Milligrams acid.		BLACK CHERRY LEAVES. 100 grams.	Milligrams acid.	
	Calc. in fresh material.	Calc. on wt. after wilting.		Calc. in fresh material.	Calc. on wt. after wilting.
After wilting to :			After wilting to :		
75 per ct. orig. wt.; sunlight	176.	235.	78.5 per ct. orig. wt.; sunlight	232.	294.
65 per ct. orig. wt.; sunlight	159.	243.	78.5 per ct. orig. wt.; mod. light	213.	271.
73.5 per ct. orig. wt.; darkness	120.	163.	75 per ct. orig. wt.; darkness	187.	250.
70 per ct. orig. wt.; darkness	128.	183.	66 per ct. orig. wt.; sunlight	186.	282.
			62 per ct. orig. wt.; darkness	118.	190.

One of the most important points to be noted in connection with this subject is the influence that the condition and stage of growth have upon the amounts of hydrocyanic acid occurring in the leaf.

The larger, tenderer, and more succulent the leaf, the greater the amount of acid that can be developed from it. To such an extent is this true, that when we come to consider the dry, woody leaves from full-grown shrubs or trees, we find the quantity of acid they yield to be so little as to render them nearly harmless. The young shoots which come up along the walls, where the custom prevails of mowing the brush every two or three years, are much the richest in the poison-yielding substance.

In the case of the black cherry, analyses were made from four different kinds of growth : (a) large, juicy leaves from suckers ; (b) large, vigorous leaves from a young tree ten feet

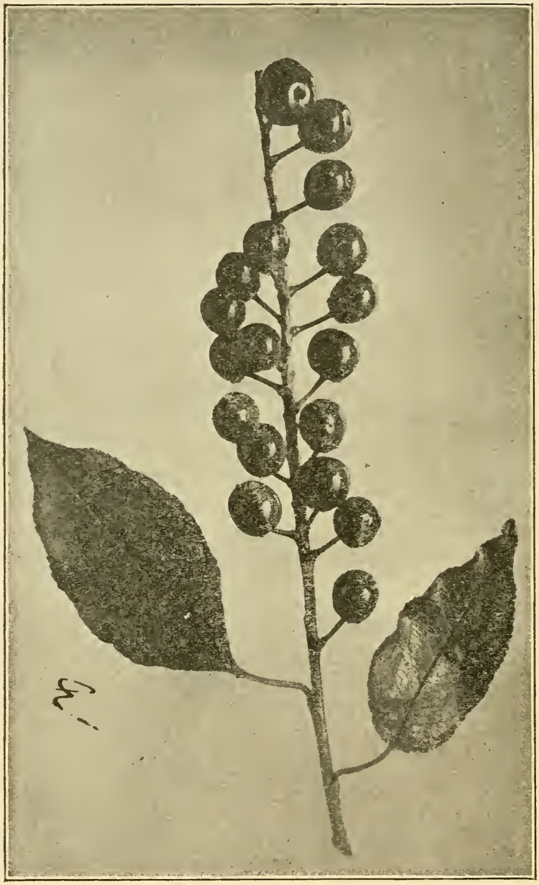


FIG. 5.—Fruit of Wild Black Cherry.

in height, growing upon a lawn (c); smaller leaves from a full-grown tree by the roadside; (d) small, dry, woody leaves from stunted shrubs growing in the shade.

TABLE III.

SHOWING INFLUENCE OF CONDITION OF GROWTH.

(Results from 100 grams freshly cut leaves.)

BLACK CHERRY.	Milligrams acid.	CHOKE CHERRY.	Milligrams acid.
(*a*) Leaves from isolated young shoots; large and succulent. Average of ten analyses..	212	(*e*) Similar to (*a*). Two analyses.......	142
(*b*) Leaves large, from vigorous young tree grown for ornament. Two analyses......	168	(*f*) Same as (*e*), but more or less "bored" by insects. One analysis.............	125
(*c*) Leaves smaller, from full-grown tree by roadside. One analysis...............	106	(*g*) Similar to (*d*) growing in shade, berries nearly ripe. Four analyses...........	33
(*d*) Leaves small, dry, and woody. Two analyses.............	42		

The average of ten analyses shows that 100 grms (about ¼ lb.) of leaves (a) yield 212 milligrams, or about 3.2 grains, acid, while the same quantity of fresh leaves (d) yields 42 milligrams acid. The same is noticeable of the chokecherry. It has been observed that the most harmful growth in the latter is that in which the large leaves are of the oval-oblong shape (Fig. 2, b). This shape seems to be a peculiarity of the young growths of this species. On the other hand, leaves from mature shrubs seem usually to possess the obovate or inverted egg form (Fig. 2, a).

The symptoms of cherry poisoning in cattle as stated by Dr. Chestnut, in his bulletin, "Principal Poisonous Plants of the U. S.," include, "labored respiration, diminished pulse, numbness, fright, protruding eyeballs, convulsions, and death

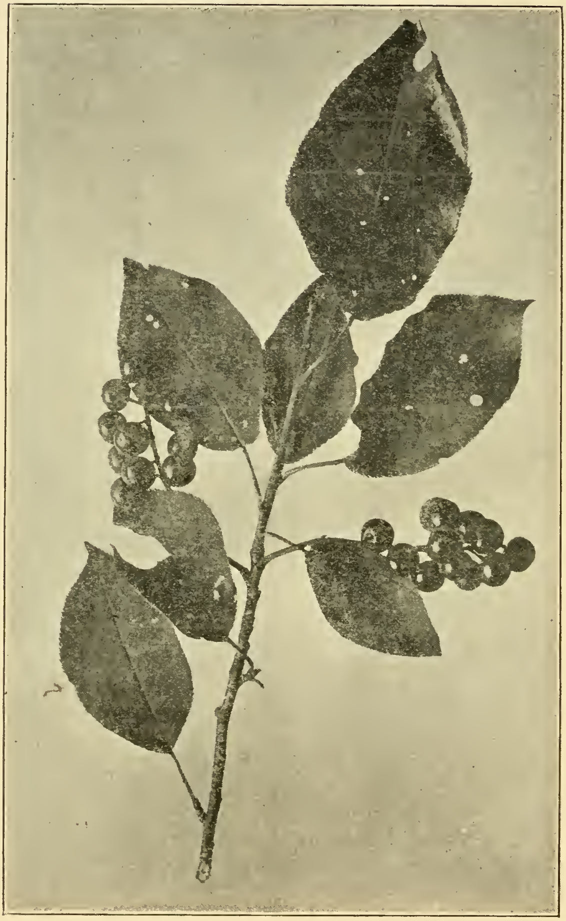


FIG. 6.—Fruit of Choke Cherry.

from paralysis of the lungs. In some cases there is considerable frothing at the mouth; in all there is a very perceptible odor of prussic acid in the breath."

According to Blythe, the fatal dose of the anhydrous acid, for an adult person, is about one grain, or 65 milligrams. At this rate, about one half pound of the black cherry leaves may be considered as a fatal quantity for a cow to eat.

During the work this summer several samples each of cultivated plum (*Prunus domesticana*), peach (*Prunus persica*), apple (*Pyrus malus*), and cultivated cherry leaves (*Prunus cerasus*) were analyzed. Those of the plum, apple, and, rather singularly, cultivated cherry yielded no acid whatever. Peach leaves showed from 77 to 100 milligrams per 100 grms. leaves; so that, in this connection, they might be classed with the leaves of the wild red cherry.

To these data may be added a few figures recorded by Blythe in his work upon poisons: One hundred grams of bitter almonds (*Amygdalus communis*), in the form of pulp, yield 250 milligrams prussic acid; the same amount of kernels from cherry stones yields 170 mgs.; leaves of the cherry laurel (*Prunus lauro cerasus*), occurring in Europe and in Mexico, 39 mgs.; kernels of peach, 164 mgs.; plum, 56 mgs.; apple seeds, 35 mgs. The stones of all these species must therefore be regarded as dangerous; the fruit, in every case, so far as can be ascertained, is harmless.

CONCLUSIONS

The leaves of the wild black cherry are the most poisonous of the three species investigated, though all are dangerous.

Both the wilted and fresh leaves are poisonous, while the dried are to be regarded with suspicion.

Vigorous, succulent leaves from young shoots, which are the ones most liable to be eaten by cattle, are far more poisonous than the leaves from a mature tree or stunted shrub.

Leaves wilted in bright sunlight to about 75 per cent. original weight, or until they begin to appear slightly limp and to lose their gloss, yield the maximum amount of prussic acid.

Bulletin 57 **September, 1898**

NEW HAMPSHIRE COLLEGE
AGRICULTURAL EXPERIMENT STATION

Experiments with Roots and Forage Crops

Ensilage Corn

BY F. WM. RANE

NEW HAMPSHIRE COLLEGE
AGRICULTURAL EXPERIMENT STATION
DURHAM

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Experiments with Roots and Forage Crops

BY FRANK WM. RANE

In winter cattle feeding, for the production of milk, many of our leading dairymen seem to regard, among others, a daily ration of green or succulent food as necessary. The source of this food at present in this state is usually the silo or some root crop, mainly the former, although some continue to grow roots.

During the past three years, various forage plants and root crops have been grown at the Station, and will be treated under these general headings.

I.—FORAGE CROPS

The changed conditions brought about through the use of the silo, together with an increasing use of soiling crops, have developed an interest in knowing the relative value of crops used for these purposes. Not only are some of these crops valuable for forage, but, as in the case of most of the legumes, they are likewise valuable for green manuring. Their real value must be solved by the individual. Conditions and kinds of soils, the domestic animals kept, together with conveniences and facilities for handling the crop, go a good way toward solving the problem. The crops considered under this head are classified under the following divisions:

A.—Gramineous forage plants.
B.—Leguminous forage plants.
C.—Miscellaneous forage plants.

A.—*Gramineous Forage Crops*

ENSILAGE CORN

Many varieties of ensilage corn have been grown at the Station for the past few years, but the question resolves itself down to two varieties, which, we believe, are the ones best adapted to our conditions, namely, the Leaming and the Sanford. The former is preferable, we believe, for the southern part of the state, and the latter, perhaps, for the northern. Both mature sufficiently for ensilage here at the Station.

The Sanford is too well known to farmers generally to need any recommendation. The first bulletin of the New Hampshire Station in 1888 points out its value for ensilage. Ever since this date, this variety has been the main crop here until three years ago. Last year we planted about half the crop to each. The present season fully three-fourths of the ensilage crop was of the Leaming.

Unlike the Sanford, which is a white flint, the Leaming is a yellow dent corn, and is one of the earliest grown. The ears are large and handsome, with deep grain and a small cob. The stalks grow to a medium size, from one to two feet taller than the Sanford; is very leafy, and usually produces two good ears to the stalk. It adapts itself to various kinds of soils equally as well as the Sanford. The comparative yields of the two varieties during the past seasons have been from two to four tons per acre in favor of the Leaming. Not only has the yield been better, but Professor Morse, who has had charge of the feeding experiments, tells me that the ensilage is equally as good as that of the Sanford, and changing from the one to the other makes no perceptible difference in the milk flow or its composition.

It is hoped that all who are interested in ensilage will give the Leaming corn a small trial at least. Fig. 1, on the cover of the Bulletin, is a photograph of four varieties; beginning at the left hand side, they are, Mosby's Prolific, Leaming, Pisers, and Sanford. Fig. 2 is a photograph of the Sanford as it stood in the field, while Fig. 3 represents the Leaming, taken

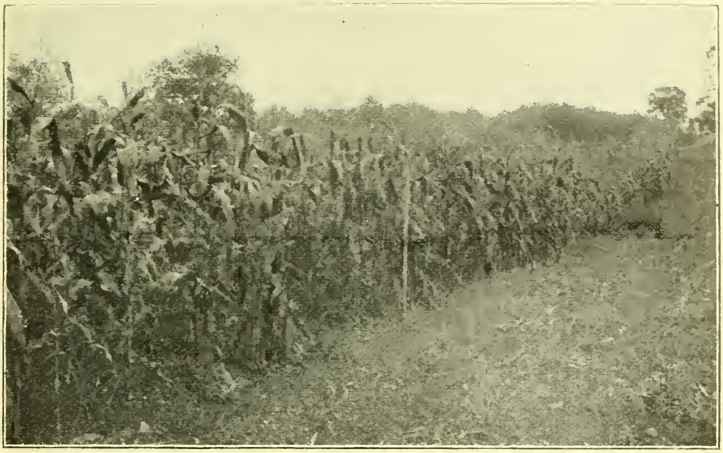

FIG. 2.—Field of Sanford Corn. Average height, 8 feet.

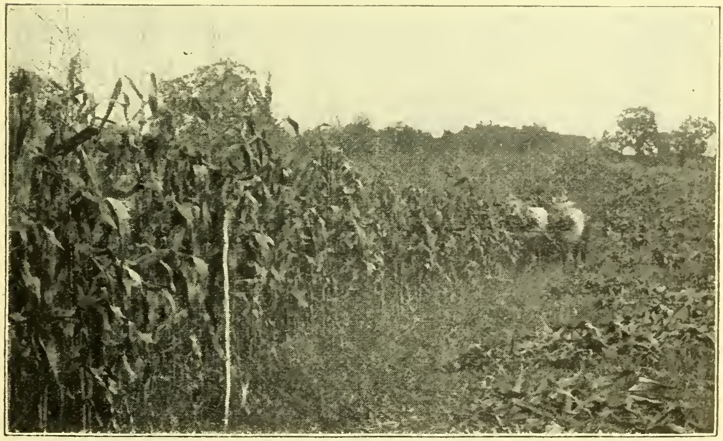

FIG. 3.—Field of Leaming Corn. Average height, 10 feet. Cutting with corn harvester.

at the same time. The pole used as a measure stands six feet high in both cases.

JAPANESE MILLETS

These new plants are much like the Hungarian in general appearance, except that they are much larger and coarser. The seed heads are likewise larger, contain proportionately larger seed, are more branched, and produce a heavier yield. Like the Hungarian, they are greedy feeders, and for best results demand a quick and available fertilizer. The seed should not be sown before June nor later than the middle of July, the quantity being at the rate of from two to three pecks per acre. The millets, when used for hay, should be cut soon after the heads are formed and before the seed has set; otherwise the stem becomes fibrous or woody.

In June of 1897, the three varieties of Japanese millets (Panicum miliaceum, P. Italicum, and P. crus-galli), together with two other samples of Japanese millet, each from reliable seedsmen, and a plot each of Golden Wonder and the New Siberian millet, were planted. All of the varieties were under similar conditions; the soil was a clay loam and fairly fertile. On September 3d, all were measured, harvested, weighed, and photographed. The accompanying table will show the comparative yield and measurements, and in Fig. 4 a single specimen of each of the first five varieties is represented by its respective number.

No.	Variety (Millet).	Measurement.	Average weight per acre.
1	Panicum Milleacum	4½ to 5 ft.	10 tons, 1,054 lbs.
2	Panicum Italicum	5 ft.	7 tons, 520 lbs.
3	Panicum crus-galli.....................	5 to 6 ft.	16 tons, 912 lbs.
4	Golden Wonder	4 to 4½ ft.	8 tons, 1,908 lbs.
5	New Siberian............................	4 ft.	5 tons, 406 lbs.
6	Japanese (Breck).................	4 to 4½ ft.	10 tons, 1,296 lbs.
7	Japanese (Henderson)............... .	4½ to 5 ft.	13 tons, 1,104 lbs.

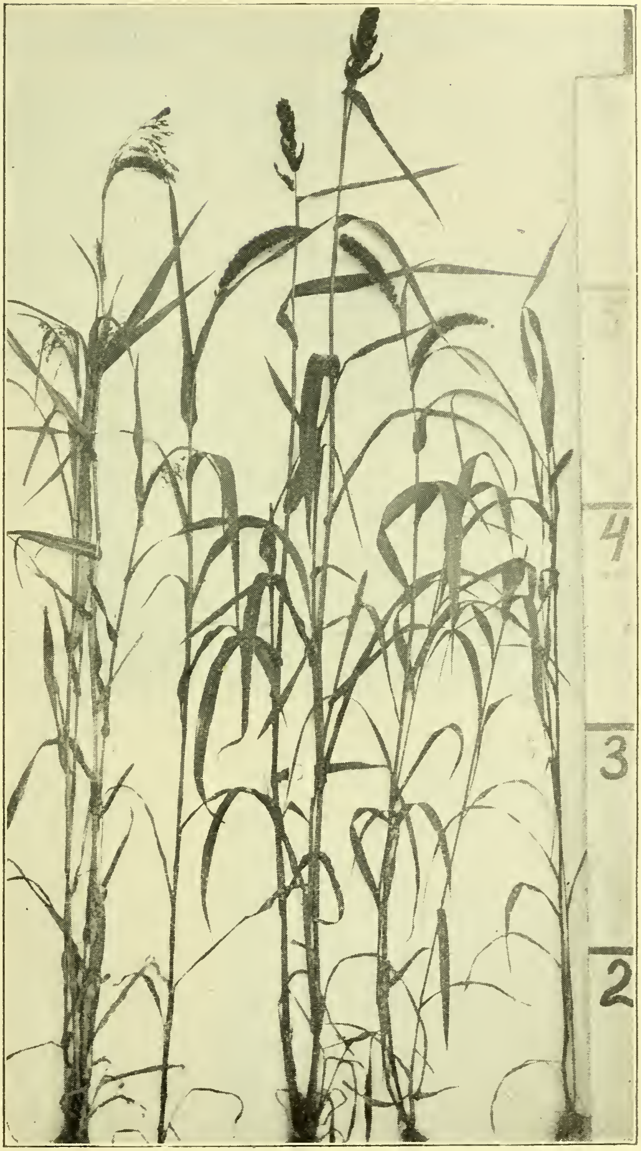

FIG. 4.—MILLETS.

1. Panicum Miliaceum.
2. Panicum Italicum.
3. Panicum crus-galli.
4. Golden Wonder.
5. New Siberian.

The *Golden Wonder Millet* has been grown very commonly here at the Station, and besides being cured for hay, it is used as a soiling crop.

The *New Siberian* is an exceptionally early variety. It doubtless would have weighed more earlier, as some of its seed was already shelled and the stalk dry. This variety could be planted much later than the others.

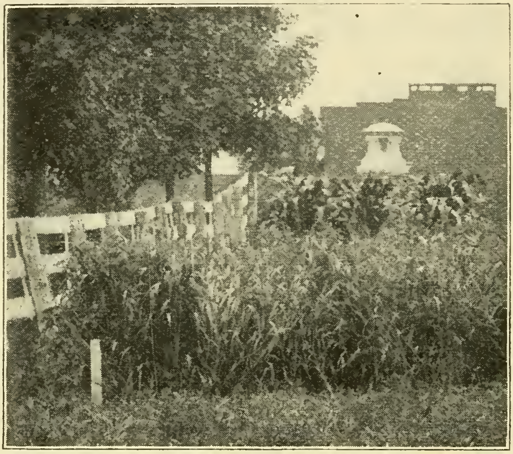

Fig. 5.—Plot of Panicum Miliaceum. (Plot stake 2 feet high.)

No. 6, Japanese Millet (Breck) proved to be a mixture of Golden Wonder and Panicum Miliaceum.

No. 7, Japanese Millet (Henderson) proved to be Panicum Miliaceum alone. From these last two samples, one would conclude that an order for Japanese millet would probably be filled with Panicum miliaceum.

Panicum miliaceum, as shown at No. 1, Fig. 4, and also in the plot, Fig. 5, has a drooping head which is much divided, and when ripe has a tendency to lodge.

Panicum Italicum, as shown at No. 2, Fig. 4, and also in the plot, Fig. 6, much resembles the Golden millet. The head is not so hairy, and the plant stands more erect.

Panicum crus-galli, as shown at No. 3, Fig. 4, and also in

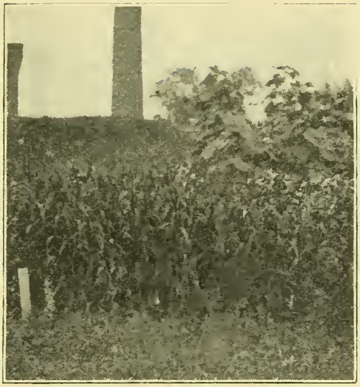

Fig. 6.—Plot of Panicum Italicum. (Plot stake 2 feet high.)

the plot, Fig. 7, grows more stalwart and erect, as well as taller than the others. The seed head has many divisions, but they stand very erect. This variety has been the heaviest yielder each year. The present season, about one acre was grown, which has been saved for seed.

These new Japanese millets are, we believe, a valuable acquisition to our forage crops, on account of the brief period necessary for their growth and the fact that they can, to some extent, take the place of either hay or corn in seasons when the latter are failures.

BRAZILIAN OR STOOLING FLOUR CORN

This corn was grown in a test plot in 1897, and grew to a height of ten feet. It was just in blossom when cut in September, making it too late for this climate. The plot looks like, and is similar to, those varieties of corn that are very prolific in suckers. Where it matures, it is said to produce a white grain, suitable for domestic uses when ground. Its yield of fodder was at the rate of 20 tons per acre.

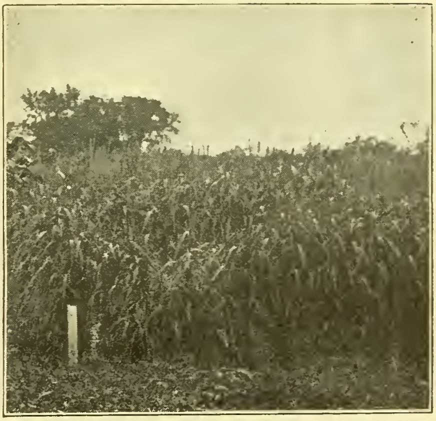

Fig. 7.—Plot of Panicum crus-galli. (Plot stake 2 feet high.)

TEOSINTE (*Reana luxurians*)

This is another of the corn type of plants. It is noted for its stooling or suckering habits. Doubtless there is no forage plant that equals it in this respect. Its origin is South America. It was grown at the Station in 1896, and did fairly well, but not in comparison with ordinary corn. Under favorable conditions, it is said to produce as high as four cuttings in a season. Its height varies from 3 to 7 feet.

KAFFIR CORN

Three varieties,—white, red, and black chaff—have been grown at the Station. They are non-saccharine sorghum, and all closely resemble one another. The white averaged from 4 to 5 feet in height, the red 4 feet, and the black chaff 5 to 6 feet. None of the varieties mature ordinarily in this climate. In 1897 about one-sixth of the white-headed came out, and none of the red or black chaff. The comparative weights of fodder per 30 foot row was, for the white, 69½ pounds; red, 59 pounds; black chaff, 103 pounds.

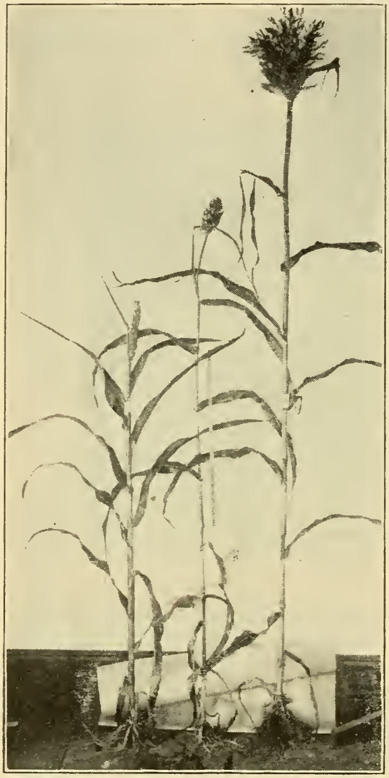

FIG. 8.—Non-saccharine sorghums. (Tallest 9 feet.)
Jerusalem corn. Kaffir corn. Milo maize.

The seed of these plants, like that of the sorghums, is borne in the heads of the plants. The name distinguishing each is typical of the color or characteristics of the seed; the white having white seed, etc. They are highly valued in some sections of the South-west, where they are grown, not only for the fodder, giving a number of cuttings each season, but also for the grain, which yields from 25 to 50 bushels per acre. The grain, when ground, compares favorably with corn meal as a feed.

MILO MAIZE OR DHOURA

This plant belongs to the same general family as the Kaffir corn, which it resembles. It reached a height with us of 6 feet, but the heads did not have time to fully open. On a 30 foot row it gave a yield of 73½ pounds, the stalks standing about 3 inches apart in the row. There are many other varieties of the Milo maize. We have grown the white, also the brown Dhoura.

JERUSALEM CORN

This is similar to the two preceding plants, only not quite as tall, nor as heavy a yielder. From a 30 foot row, the yield was 54 pounds. The plant does not mature in this climate.

B.—*Leguminous Forage Crops*

THE SOY BEAN (*Glycine hispida*)

This plant has been under cultivation at the Station for the past four seasons; it is an introduction from Japan, where it has been cultivated from a very early time. The Soy bean has been known in this country for some time, but it is only within recent years that its value has been demonstrated. Its main value, and that for which we have been growing it, is as a forage crop. The composition of the plant shows a high percentage of food ingredients, and, as it is one of the leguminous plants, it doubtless derives much of its nitrogen from the air.

There are many varieties, which at present are classified by a few seedsmen into early, medium, and late; others offer simply Soy or "Soja" beans, which we find are usually the late variety. In 1895, about three-fourths of an acre was grown, but due to an early frost was not harvested in the best condition. This

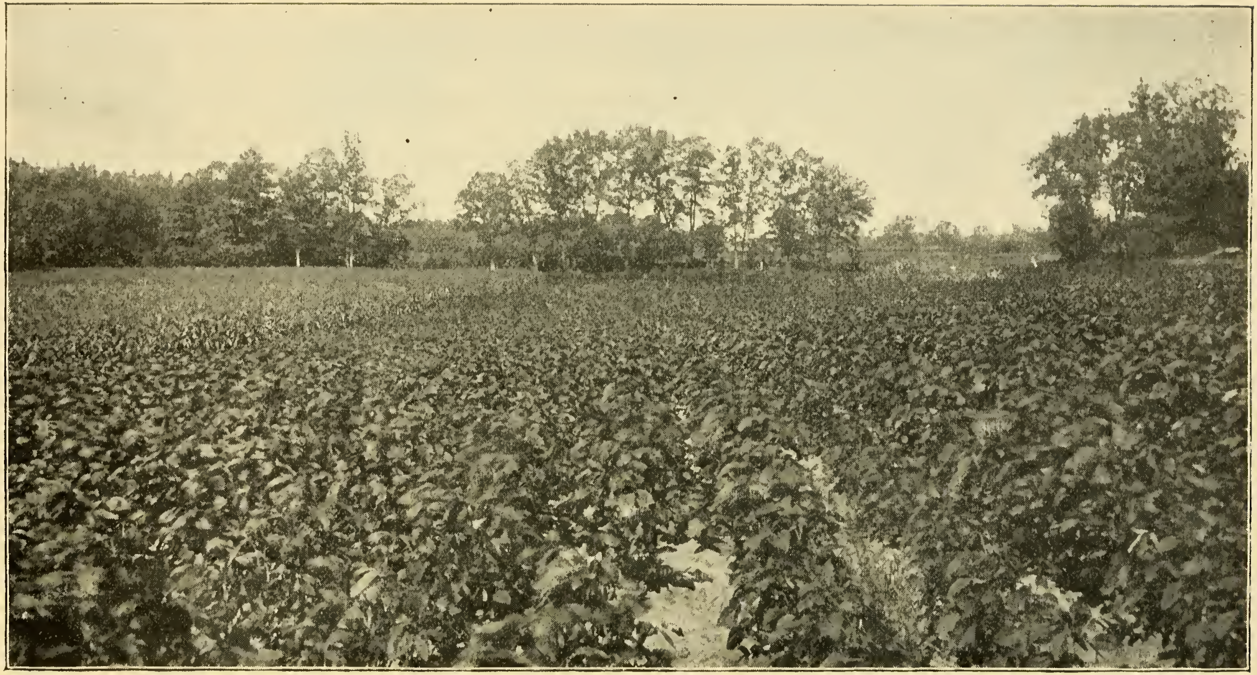

FIG. 9.—Field of late Soy Beans, 1896. College Farm. (Sanford corn on the left.)

was cut into the silo. In 1896, about two and one-half acres were grown, a photograph of which is shown in Fig. 9. This was in blossom when cut into the silo, being of the late variety. During 1897 and 1898, a fair-sized area, besides small variety test plots, has been grown. Fig. 10 contains a specimen of each of the early, medium, and late varieties, taken in September of the present season, and represents their various degrees of development. No. 1 is dead ripe, with leaves fallen; it contains, on an average, from 40 to 75 bean pods, with from 2 to 3 beans each. No. 2 is the medium early variety, and, although green when harvested, the seed was matured. No. 3 is the late variety, and although of good size, it was still in blossom when photographed.

The average yield of each variety per acre, when grown upon a fairly rich, clay loam, although poorly drained, was, for the early, No. 1, 2 tons, 1,808 pounds; for the medium-early, No. 2, 4 tons, 1,922 pounds; and for the late, No. 3, 4 tons, 1,680 pounds. The seed of the early is brown, while that of the medium-early is black. All things considered, the medium-early variety is the best, on account of its maturing a large quantity of seed as well as making a fine leafy growth, thus enabling one either to sell the seed, or convert the whole into silage. When the crop is to be cured for hay, it should be cut when in blossom. Cows eat it, but do not seem to relish it much. It is always advisable to feed it with fodder corn, millets, etc., when used for soiling. Likewise when mixed with corn for ensilage, it forms a very valuable concentrated food. Our experience has been that, when cut into the silo, the chief objection is its woody, indigestible stem.

The seed in all instances, with the exception of one experiment this present season, has been sown in drills three feet apart, with seed dropped one foot apart in the row, which requires about one-half bushel per acre. The method of cultivation was exactly the same as that given corn.

The idea that this plant will grow equally well on wornout soils, without fertilizer, is an erroneous one. It is necessary to either fertilize the land, or use soil in good heart already, if an average crop is expected. Potash, phosphoric acid, and lime

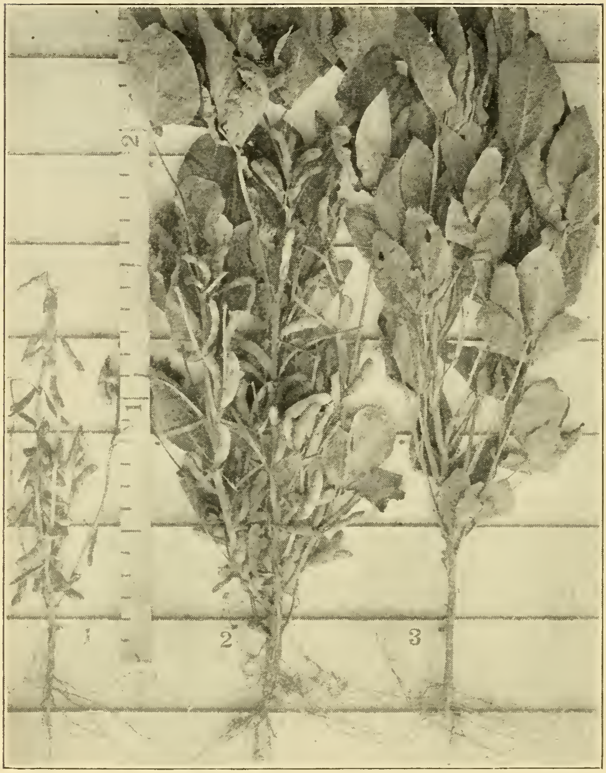

FIG. 10.—Soy Beans, 1898.

1. Early. 2. Medium 3. Late.

are recommended as the fertilizers best adapted to its growth, but we find that nitrogen is equally beneficial, especially when no turf is plowed under. In an experiment for testing this, four formulas were used; two recommended by the Massachusetts Station, one by the Delaware Station, and the fourth compounded by ourselves. One-fourth acre plots were used. The following is the composition of the fertilizers used per acre:

No. 1 (Mass.), 10,000 lbs. manure; 125 lbs. sulphate potash; 200 lbs. dissolved bone black.

No. 2 (Mass.), 320 lbs. nitrate soda; 275 lbs. muriate potash; 550 lbs. dissolved bone black.

No. 3 (Del.), 160 lbs. nitrate soda; 160 lbs. muriate potash; 400 lbs. dissolved bone black.
No. 4 (N. H.), 125 lbs. nitrate soda; 275 lbs. muriate potash; 200 lbs. dissolved bone black; 250 lbs. ground bone.

The field used was in cultivation with corn the previous season. The yield per acre was as follows:

Plot No. 1 = 5 tons, 1,157 lbs.; No. 2 = 6 tons, 1,608 lbs.; No. 3 = 4 tons, 1,720 lbs.; No. 4 = 4 tons, 262 lbs.

The following season, the same fertilizers were used on land with a comparatively heavy, old grass sod, plowed for the first time in a number of years. The yields were as follows: Plot No. 1, 1 ton, 952 pounds: No. 2, 2 tons, 608 pounds; No. 3, 4 tons, 256 pounds; No. 4, 3 tons, 1,160 pounds.

In an experiment carried on the past season in reference to seed sown in drills and broadcast, there was a yield of 5 tons, 400 pounds, as against 2 tons, 1,200 pounds in favor of the broadcast method. It must be said, however, that the beans in rows did not receive the cultivation usually given, and that both plots were not sown until June 15th. When sowing broadcast, use from one to two pecks more seed per acre.

From our experience thus far, we do not advise farmers to go into raising the Soy bean on a very extensive scale, until its value as a food has been more thoroughly demonstrated. It has not come up to our expectations. The land, of course, may not be adapted to it. However, taking into consideration the facts that its yield is so small compared with corn; that it requires fully the same amount of cultivation and labor in handling, though it is less bulky in harvesting; that it is not relished by cattle, and that there is more or less indigestible matter in the woody stem, we are not prepared to recommend it until we have had further experience with it.

THE COW PEA (*Dolichos etang*)

This plant is grown very commonly in the South, and is considered there as one of the plants best adapted to green manuring. Like the Soy bean, it is a leguminous plant; hence, a nitrogen gatherer, composed of valuable plant food. If, as is shown from experiments, this plant is so valuable in bringing up the fertility of land in one section, why should it not be of equal value in another?

The cow pea has been grown now for two seasons. The trial plots have been on a fairly rich, clay loam, although poorly drained. The seed was planted in rows three feet apart, and from four to six inches apart in the row, which is at the rate of about one bushel per acre. When sown broadcast, one and one-half bushels are necessary. The following varieties have been grown:

Whippoorwill	Ga. Exp't Station	8 tons, 133⅓ lbs. per A.
Whippoorwill	Breck & Sons	15 tons, 976 lbs. per A.
New Era	Ga. Exp't Station	12 tons, 684 lbs. per A.
Southern Yellow Eye	Breck & Sons	18 tons, 300 lbs. per A.
Clay or Wonder	Breck & Sons	14 tons, 1,040 lbs. per A.
Southern Black Eye	Johnson & Stokes	15 tons, 1,460 lbs. per A.

The plant is of a running nature, and in a short time completely covers the ground, whether sown in drills or broadcast. It is, consequently, a troublesome crop to turn under. As a soiling and silo crop, it does not seem to be a success; the cattle do not take to it as freely even as to the Soy bean. Its main value seems to be as a green manure. Besides the plots already mentioned, two other tests are under trial. During the season of 1897, a small, triangular field of comparatively poor soil was planted, which yielded at the rate of 6 tons, 1,649 pounds per acre. This was plowed under and the ground stocked down to grass in the fall. The grass winter-killed. The ground was wet until late, so that the results will be untrustworthy until another season. This year, another good-sized plot of similar conditions was sown with cow peas, and although late when planted, they have produced at the rate of 6 tons of green material per acre.

It is thought by the writer that this crop should be given more consideration, from the facts that it is so easily grown, yields so heavily, and seems to adapt itself to comparatively poor soils. When plowing under in the fall of 1897, the roots were found to be well covered with tubercles, being in some instances as large as hickory nuts. The plants rarely grow over 2½ feet in height, averaging usually about 2 feet.

RUSSIAN VETCH (*Vicia villosa*)

This plant has been grown at the Station in small plots during the past three years. The seed resembles that of the pea, but is much smaller, being about the size of ordinary buckwheat, only round. The plant is a legume, and therefore, like clover, is valuable as a nitrogen gatherer. The United States Department of Agriculture introduced the seed into this country, in 1886, from Russia. The seed is sown in this climate usually during May or early June for summer forage, and during August for winter forage, at the rate of 1½ bushels per acre. The plant is said to have been tested in all parts of this country, and found to be both hardy and drought-resisting.

A plot was sown to vetch the fore part of June the present season, and the crop was not cut until the middle of September, at which time the plants stood on an average 20 inches high and were very thickly matted. When cut, it averaged in the green state at the rate of 13 tons, 1,588 pounds per acre. The soil was a fairly rich loam. The natural tendency of the plants to mat thickly renders it a hard crop to harvest or to plow under as a green manure. When some erect-growing crop is grown with it, it stands up better. This was evident when the seed was sown broadcast and weeds came up, helping to hold up the vetch. It doubtless would do much better if sown like peas with oats. Vetch is being tested in other places in the state, and doubtless will be more commonly known in the near future.

OATS AND CANADA PEAS

Neither oats nor peas, when planted by themselves, give sufficient weight to make them valuable as forage crops, but when sown together, they produce a fairly heavy yield of valuable fodder. The yield per acre varies according to the ground used and its state of fertility. Our custom has been to sow them in early spring, utilizing them for soiling until they are matured sufficiently for hay, which is usually the latter part of July. Then the remainder of the field is cut and cured. The amount of seed for best results is, we believe, 1 bushel of peas to 1¼ of oats. The peas should be well covered, and the oats sown broadcast and brushed in afterward. Coming off early, as they do, a second crop can easily be grown upon the same land. Fig. 11 is a photograph of a crop of oats and peas grown on the College farm in 1896.

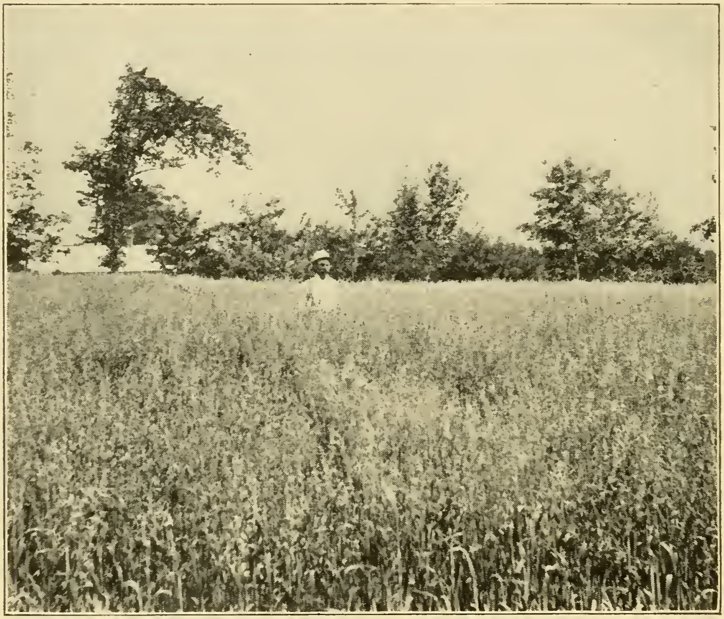
FIG. 11.—Oats and peas, 1896, College farm.

The fertilizer commonly used by us is 170 pounds dissolved bone black, 170 pounds ground bone, 210 pounds muriate of potash, 45 pounds dried blood, and 45 pounds nitrate of soda per acre. Anywhere from 2½ to 4 tons of green forage is an average crop under ordinary conditions. The pea belongs to the leguminous plants, and like them contains a high percentage of plant food, which constitutes its value.

CRIMSON CLOVER (*Trifolium incarnatum*)

This species of clover has received the attention of the Station throughout the past three years, and has already been reported upon in Bulletin No. 37, July, 1896. Our experience with it has been such as to lead us to discard it. It doubtless would be valuable where the climate is milder and more favorable for its growth, but in New Hampshire, we believe it has little value, as compared with other plants. A report on sowing the seed at various times throughout the year will appear in the Annual Report of this year.

LUPINE (*Lupinus albus*)

The white variety of lupine has been grown for the past two years. As it readily matures, when sown in early spring it usually is ready to turn under as a green manure in early August. This crop is used to quite an extent in Europe for this purpose. The plants grow on an average 2 feet, 4 inches high with us, and when allowed to ripen, their fruit produce at the rate of from two to three pods, containing four beans each, per plant. The seeds contain a bitter alkaloid, which is injurious to animals in the crude state. In Europe, this objectionable feature is overcome by soaking them for a day or two in water frequently changed, and then boiling for an hour, when the process of extraction, through stirring and changing the water, is again carried on for two days longer. After this process, the residue, which is now relieved of the alkaloid, makes a highly nitrogenous food, and is fed at the rate of five pounds a day per 1,000 pounds live weight.

The seeds are about the size of Lima beans. We sowed them in rows, 3 feet apart, and cultivated between the rows, but they doubtless would do well, and perhaps give a heavier yield if sown broadcast. There are two other varieties, which are more commonly in use,—the yellow and blue lupines. Our soil was heavier than that for which they are recommended; they should be grown upon light, rather sandy soils, where they are said to make a rapid growth. Belonging as they do to the leguminous order, they enrich the soil in nitrogen besides adding organic matter. It naturally follows that when the crop has been turned under and as soon as decomposition begins to set in, another crop should be planted, in order to derive all the benefits from it.

SERADELLA (*Ornithopus sativus*)

This is a leguminous crop adapted to both forage and green manuring. It did not make a strong enough growth when sown by itself to ensure a crop. We have not tested it with a protective crop, but think it may have value when handled as ordinary red clover. It does best like the lupine on sandy soils, but does not contain the objectionable alkaloid ingredient found in the lupine.

SAINFOIN (*Onobrychis sativa*)

The claims for this plant are that it can be grown on dry and calcareous soils which are too barren for clovers. It is said not to thrive upon low, wet, or marshy land. Mr. Jared G. Smith writes: "There is no better plant for growing on barren hills, but it does better on the sunny slopes than those facing north. It is difficult to establish, as the plants are easily killed when young, but when well-rooted, sainfoin will live from twenty to twenty-five years, or sometimes a hundred years, provided the soil is rich enough."

In Europe one crop a year is cut which averages about the same as our ordinary hay crop. The actual food value of sainfoin is higher than that of clover. The crop is not adapted for pasturing, as it is said not to have the recuperative quality of the clovers. Like many of the legumes it is deep-rooting and also is a perennial. Our plot was very backward and hard to establish. The seed doubtless was old as but a small percentage germinated. The seed loses its vitality readily, and should be fresh, if possible, each year. Eighty pounds per acre are recommended for a sowing of unshelled and forty pounds of shelled seed, and it should be covered deeply to ensure germination. The seed is sown in early spring and the crop is harvested when in blossom. Our soil does not seem to be adapted to it, but doubtless there is land in the state where it could be utilized to great advantage. The United States Department of Agriculture tells us that it can be grown anywhere within the United States.

C.—*Miscellaneous Forage Crops*

RAPE

This plant has been grown and fed to sheep very commonly in Canada. On a good-sized plot it made a very heavy growth here in 1896. We found, however, that it was seeded too thickly. Where the plants were given more room, as at the outer edges of the plot, they grew much more luxuriantly. During the past season a plot sown in June and not cut until September gave a yield at the rate of nearly 50 tons to the acre. It is advisable of course to feed it before the stem gets too woody. The rape can be used as a catch crop and sown any time up until late summer. If cut early it sprouts up and produces a second and sometimes a third cutting. The plant belongs to the cabbage and kale tribe, and therefore can withstand a light frost, which makes it useful at the latter end of the season as a forage crop. However, it runs out the land quickly, and therefore must be considered as a ravenous feeder. The variety commonly grown is the Dwarf Essex. It was, however, the Dwarf Victoria that gave the heavy yield this past season.

KALE

This belongs to the same family of plants as the cabbage, turnips, rape, etc. Like them it is a plant adapted for feeding purposes and withstands a low degree of temperature. The part sought for is the leaves, which are very numerous, usually curly and thick. This plant is used for greens as well as for stock. Like rape it produces a large crop and is a heavy feeder. The variety grown at the Station was the Thousand-headed kale, which was sown in the spring and cut in August, yielding at the rate of 47,432 pounds per acre. When grown in the garden, it is started in seed beds or trays and transplanted the same as cabbage or cauliflower.

SPURRY (*Spergula maxima*)

A large plot was sown to spurry three years ago, when it thickly covered the ground with a fluffy, light crop of forage. It reached a height in the tallest spots of two feet but averaged nearer one foot. The seed germinates immediately upon being sown but the plants grow rather slowly. It belongs to the pink family and is adapted to sandy soils. The second year it seeded itself, and made about the same growth as the year before. It did not make sufficient growth to be considered of value. Upon much lighter soils, however, it is claimed to be valuable.

THE SUNFLOWER

In recent years the sunflower has rapidly become a crop of recognized value. It is grown by a few at present in New Hampshire as a food for fowls. As many inquiries in regard to the culture of the crop have been made, we give the following data, from three varieties of Russian sunflowers grown here during the past two seasons. The seeds were planted in rows three feet apart and one foot apart in the row. The large Russian variety (Henderson) averaged from 6 to 10 feet high and produced a large head. The heads alone of this variety, when harvested, produced at the rate of 11 tons, 1,958 pounds per acre. The other two varieties are the so-called White Russian and the Grey Russian, both of which were sent out by the United States Department of Agriculture. The former averaged from 4½ to 6 feet in height and the heads yielded at the rate of 9 tons, 1,360 pounds per acre; while the Grey variety averaged from 5 to 7 feet in height, producing at the rate of 10 tons, 812 pounds per acre.

Considering this heavy yield and the fact that the seed contains a large percentage of highly concentrated food, there can be little question as to its value when properly fed in connection with other more succulent foods. It is believed more use should be made of this plant. The culture ordinarily given corn answers equally well for sunflowers.

IDAHO FIELD OR COFFEE PEA

Seed of this plant was sent us by the Barteldes Seed Company. A plot 9x10 feet was sown in the spring of 1896, which produced plants 2 feet, 4 inches in height by September. The plant sent out a flower which developed into a pea-pod from ¾ to 1 inch long, at the base of each leaf. As the pods of the older leaves formed, the plant continued growing and flowering, making fruit and flowers on the same plant. The plot weighed in the green state, 35 pounds, or at the rate of 8 tons, 940 pounds per acre.

SACALINE (*Polygonum sachalinense*)

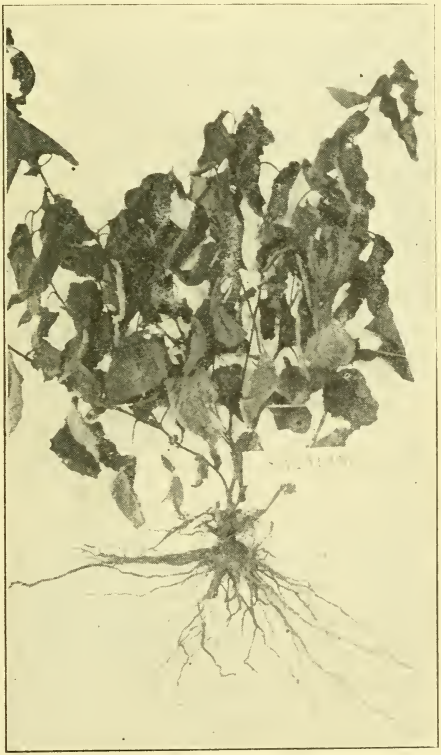

FIG. 12.—Sacaline. (First season's growth from transplanted seedling.) Height 2 feet.

This plant has caused as much sensation as a new forage crop for the last few years as any of the so-called new introductions. It is not, however, as valuable as it was first claimed to be. We began testing it in the spring of 1896. The seed was first sown in trays in the greenhouse about the first of March and when the ground outside was in good condition to receive them, the seedlings were transplanted into rows three feet apart and the plants set eighteen inches apart in the row. One-fourth of an acre was transplanted. The following September the plants had attained a height of about two feet. Fig. 12 is a photograph taken at that time and shows the results of one season's growth. At this time the main stems were very fibrous and woody and therefore very indigestible. If used for forage it is necessary to cut them often. Our cattle ate the succulent part readily. The following spring not over one-twentieth of them were alive; they heaved badly, being of such a large root growth. The soil too was a clay loam. Even those that did live seemed to be affected by the severe winter and made a rather indifferent growth the next season, not reaching over four and one-half feet in height. They were given no care and have at the present writing all disappeared. If planted in light ground we believe the results would be much better. They are very vigorous growers and when once established in a suitable climate, we believe they would make considerable forage, and in fact be a very troublesome plant to eradicate. To grow them from seed sown in the field is a discouraging undertaking. On the other hand, twenty-five cents per plant is too expensive should a person desire to test them. They are easily grown under glass or indoors at a window. Like many other of the novelties, they may do well where drouths and forage famines are frequent; but where corn and other suitable crops are so readily grown, we believe there is no use for them.

GIANT BEGGAR WEED

This plant was grown during the past season in a plot 9x10 feet. The seed was sown in early spring. At the end of the season the largest of the plants stood 4½ feet in height and each had branched, closely to the ground into from seven to nine main shoots, thus making a large head. The leaf resembles the cow pea in general shape and appearance. The main stems of the plant, like the sacaline, become very fibrous when allowed to grow beyond the succulent stage. The claims for the plant are its adaptability to poor soils and its highly nutritious food value as a forage crop. It is thought to be of special value for the South. We doubt its value for New Hampshire unless it can be made to grow upon land now entirely worthless.

II.—ROOT CROPS

During the past three years root crops have been grown to a limited extent and fed to the College herd. They have been replaced by ensilage in most sections in late years, and while this has been to the advantage of farmers generally, we must not forget that roots have their value. It often happens that roots can be used to advantage as a catch crop; also, that land under certain rotations would yield a crop of roots with relatively little loss of plant food. Even where ensilage is commonly the succulent food, every herd has its complement of dry cows, young stock, and bulls that will utilize the roots to advantage. They can readily be shifted from one place of feeding to another, the only thing necessary being to keep them from freezing.

As compared with ensilage corn, roots are more troublesome to raise for the general farmer, for where cultivation with comparatively little hand-hoeing is required with the former, with roots hand-hoeing and weeding are important problems. Under the best conditions as much digestible dry matter can be raised per acre with roots as with ensilage corn. The problem is mainly one for the individual to settle, as the nature of the soil, conveniences for handling, the animals to be fed, etc., are all-important factors. Doubtless a person who leans toward gardening will make better success with root crops than one more interested in general farming, as they need the care and attention the former would give.

Wohauka Sugar Beet.—Two varieties, Nos. 1 and 2, the seed of which was sent us by the Austrian government, have been grown at the Station. They yielded on an average 9 tons, 880 pounds per acre. These varieties are both shown in Fig. 13.

Mammoth Long Red Mangel-Wurzel, Fig. 13.—This is a long, red, smooth-skinned variety, of large size, and a heavy yielder. In 1896 under ordinary culture it produced 17 tons, 880 pounds.

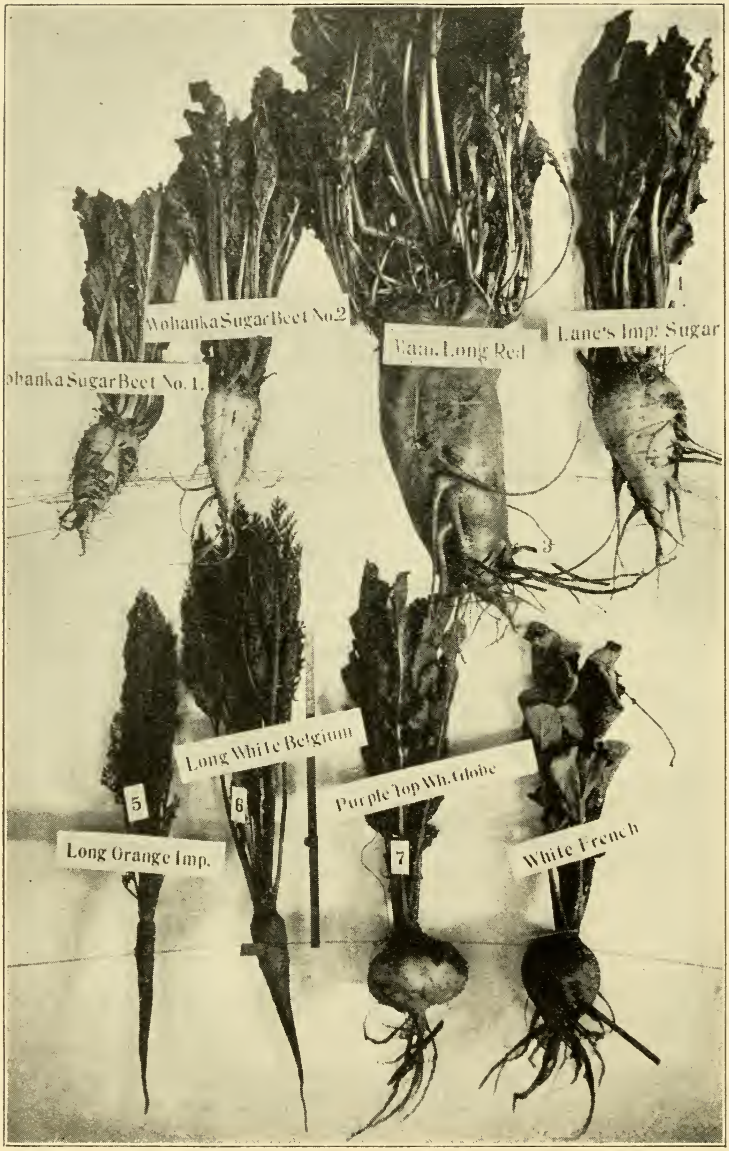

FIG. 13.—Root Crops.

Lane's Improved Sugar Beet, Fig. 13.—A well-known and commonly-grown cattle beet. Yield per acre, 11 tons, 560 pounds.

Long Orange Improved Carrot, Fig. 13.—This variety as its name implies is very long and slender and can be used for either the table or for stock. Its yield was only 4 tons, 1,920 pounds per acre.

Large White Belgian Carrot, Fig. 13.—This is considered one of the most profitable for feeding stock. The yield per acre was 9 tons, 880 pounds.

Purple Top White Globe Turnip, Fig. 13.—A large, round variety, grown for table use as well as for stock. Yield, 12 tons per acre.

White French Rutabaga, Fig. 13.—This is a fine stock variety; also can be utilized for the table. Firm, white, and solid. In 1896 it produced at the rate of 25 tons, 1,200 pounds per acre.

Skirving's Purple Top Rutabaga.—During the past season this variety was grown on quite a large area, and gave a very fair yield. It resembles the Purple Top White Globe. Large, yellow, firm, and a good keeper.

	Yield per acre.	Yield of dry matter per acre.	Yield of digestible matter per acre.
	Lbs.	Lbs.	Lbs.
Sugar Beets, No. 1	18,880	2,772	2,615
Mangolds, L'g red cattle	34,880	3,681	2,898
Sugar Beet, Lane's Imp	22,560	3,313	3,125
Turnip, Purple top Wh. Globe	24,000	2,586	2,255
Rutabagas, White French	51,200	5,517	4,833
Ensilage Corn (average)	30,000	7,500	

The root crops are so largely composed of water that one gets a very vague idea of the real dry matter from the total weight per acre. In order that this may be compared with the dry matter of ensilage, which is usually estimated as being one-fourth, or 25 per cent., I have computed the accompanying table. Besides giving the total dry matter, it also contains the digestible dry matter. These computations are based upon the chemical analyses of the Maine Station, which it is thought answer equally well for our conditions.

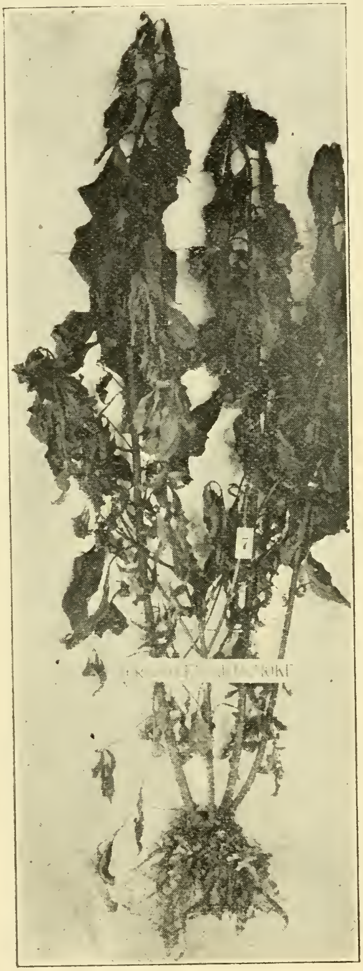

FIG. 14.—Jerusalem Artichoke. Height 5 feet.

Jerusalem Artichoke.—This plant is grown for the fleshy tubers which form about the roots just beneath the surface of the soil. They are the only parts used for propagation and in this respect the plant resembles the potato. They are very irregular in outline, being about 2½ inches long and half as thick, usually tapering at both ends. The eyes unlike those of the potato protrude, producing more or less of a knobby appearance. The roots or tubers are cut to single eye cuttings, and planted usually in rows three feet apart and two feet apart in the row. Three bushels of roots are enough to plant an acre of ground. Cover the seed about two inches deep. Fig. 14 is a plant photographed in October of 1896, representing the growth of one season. Its height was 5 feet and it contained 15 tubers.

This crop is commonly recommended as being adapted for feeding hogs; the animals are turned into the field and allowed to do their own digging. The tubers are not very deep and therefore accessible. The large percentage of starch contained in them makes them a valuable food. They may be dug and fed the same as other roots.

A very interesting pamphlet setting forth the value of the Jerusalem Artichoke, was sent to the Station about a year ago, which recommended, besides utilizing the tubers, the making of silage out of the tops. We have not yet tried this. This plant is a favorite food of the woodchuck, which persists in eating down the top, especially in early summer. Under certain conditions doubtless this plant can be used to advantage.

REMARK

As there are so many crops treated and each as briefly as possible, a table of contents is given in the fore part of this Bulletin, which is to take the place of the usual summary.

Bulletin 58 **October 1898**

NEW HAMPSHIRE COLLEGE
AGRICULTURAL EXPERIMENT STATION

The Cost of Raising Calves

The Experiment Station Building

By **FRED W. MORSE**

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
Durham

NEW HAMPSHIRE COLLEGE

OF

AGRICULTURE AND THE MECHANIC ARTS

AGRICULTURAL EXPERIMENT STATION

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Bulletin 50—Dehorning Cattle. February.
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Bulletin 52—Growing Muskmelons in the North. April.
Bulletin 53—The Farm Water Supply. May.
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Bulletin 55—The Feeding Habits of the Chipping Sparrow. July.
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Bulletin 57—Forage Crops. September.

THE COST OF RAISING CALVES

BY FRED W. MORSE

During portions of 1897 and 1898 careful records were kept of the amount of food consumed by several calves and yearlings for the purpose of securing data from which to calculate the cost of raising a dairy cow. In addition to our own data, we have collected and compared all similar figures to be found in the bulletins of the American experiment stations. This bulletin is written in order to give the farmers of New Hampshire as close an approximation as possible to the probable cost of raising heifer calves to the age of sixteen months. It is planned to continue the work, and in the future, issue another bulletin giving the cost up to the stage of growth at which the animal will pay her own expenses.

The general method of feeding calves, during the periods mentioned in this bulletin, was as follows:

The calf was taken from the cow as soon as the latter's milk was fit for creamery use. It was first fed with whole milk, which was gradually replaced by skim-milk, until by the end of the second week of growth it received only milk that had been run through the separator, and was almost completely free from fat. To replace the fat, a mixture of ground flax-seed, cooked in water, was added to the milk. The proportions in this mixture were one pound of flax-seed to four quarts of water, making a thick mucilaginous jelly, which could be readily mixed with the milk. The calves were fed from seven to ten quarts of skim-milk and one or two quarts of flax-seed jelly, daily, in two feeds. During part of the time middlings were cooked instead of flax-seed. As soon as possible the animals were encouraged to eat grain and hay, and the increase in food made necessary by gain in size and weight, consisted of these materials, while the skim-milk and flax-seed remained nearly constant in amount as long as they were used, which was up to the age of six to eight months, or until the animals' first season in the pasture. Some of the calves were taught to drink from a pail; but most of them were given their milk through Small's calf feeder, since it made the work of feeding much less.

Careful watch was maintained to note any indigestion; therefore diarrhœa or "scouring" was quickly stopped by reducing the quantity of food and adding lime-water to the milk. Little difficulty was experienced in keeping up a steady growth in size and gain in weight. Differences were always noticeable between individual animals in the rate of growth and amount of food consumed. Large animals invariably required more food to maintain their condition than small ones.

The quantities of food consumed, and cost of the same, together with the breeds, ages, weights, and weekly gains are given in the following tables, which for convenience are arranged to show six successive stages of growth. The records include thirteen individual animals, and all seasons of the year.

In calculating the cost of the food consumed by the animals, the following scale of prices was adopted as representing a fair approximation to actual prices at various seasons of the year:

	Per 100 lbs.
Milk	$1.00
Skim-milk	.20
Flax-seed	3.25
Middlings	.80
Bran	.70
Linseed	1.25
Oats	1.00
Oatena	.65
Mixed grain (2 parts middlings, 2 parts oat-feed, 1 part linseed)	.90
Hay	.50
Green barley fodder	.15

The different breeds are indicated by the abbreviations, J, Jersey; J. G., Jersey grade; H. G., Holstein grade; A., Ayrshire; D., Durham; D. G., Durham grade, and Gy., Guernsey.

COST OF FEEDING CALVES.—CALVES UNDER FIVE WEEKS OLD.

No. of calf.	Breed.	Weight at beginning.	Length of period, in weeks.	Weight at end.	Ave'ge weekly gain.	Kinds and quantities of food consumed. Whole period.	Total cost of food.	Ave'ge weekly cost of food.
		Lbs.		*Lbs.*	*Lbs.*	*Quantity in pounds.*		
6	H. G.	92	May 3 to June 5, '97, 33	130	8	36 milk, 516 skim-milk, 9¾ flax-seed, 19 oats	$1.89	$.40
7	J.	64	Aug. 21 to Sept. 18, '97, 28	92	7	24 milk, 424 skim-milk, 6¼ flaxseed	1.29	.323
8	J. G.	79	Sept. 4 to Oct. 2, '97, 28	102	5.75	112 milk, 784 skim-milk, 14 flax-seed	3.14	.785
9	D. G.	86		115	7.25			
10	A. & D.	100	Sept. 4 to Oct. 2, '97, 28	130	7.5	70 milk, 490 skim-milk, 5¼ flax-seed, 7 middlings	1.90	.475
11	A.	86	Nov. 30, '97, to Jan. 1, '98, 32	128	9.2	90 milk, 438 skim-milk, 8 flax-seed, 2 linseed, 7 hay	2.09	.457
12	J. G.	70	Dec. 7, '97, to Jan. 1, '98, 25	95	7	54 milk, 372 skim-milk, 7¾ flax-seed	1.53	.428
13	A.	72	Dec. 11, '97, to Jan. 8, '98, 28	100	7	64 milk, 356 skim-milk, 5¼ flax-seed, 1 linseed	1.53	.383

From Five to Nine Weeks Old.

No. of calf.	Breed.	Weight at beginning.	Length of period, in weeks.	Weight at end.	Ave'ge weekly gain.	Kinds and quantities of food consumed. Whole period.	Total cost of food.	Ave'ge weekly cost of food.
6	H. G.	130	June 5 to July 3, '97, 28	174	11	504 skim-milk, 10 flax-seed, 44 oats, 21 middlings, 42 hay	2.15	.538
7	J.	92	Sept. 18 to Oct. 16, '97, 28	122	7.5	406 skim-milk, 1¾ flax-seed, 28 mixed grain	1.11	.278
8	J. G.	102	Oct. 2 to Oct. 30, '97, 28	137	8.75	896 skim-milk, 14 flax-seed, 42 middlings, 21 hay	2.40	.60
9	D. G.	115		159	11			
10	A. & D.	130	Oct. 2 to Oct. 30, '97, 28	176	11.5	560 skim-milk, 5¼ flax-seed, 28 middlings, 10 hay	1.56	.39
11	A.	128	Jan. 1 to Jan. 29, '98, 28	165	9.25	448 skim-milk, 10½ flax-seed, 3½ middlings, 48 bran, 4 linseed, 33 hay	1.81	.453
12	J. G.	95	Jan. 1 to Jan. 29, '98, 28	124	7.25	448 skim-milk, 10½ flax-seed, 3½ middlings, 4 linseed, 21 hay	1.42	.38
13	A.	100	Jan. 8 to Feb. 5, '98, 28	126	6.5	448 skim-milk, 3½ flax-seed, 7 middlings, 3½ linseed, 28 hay	1.22	.305

COST OF FEEDING CALVES.—NINE TO THIRTEEN WEEKS OLD.

No. of calf.	Breed.	Weight at beginning.	Length of period, in w'ks.	Weight at end.	Ave'ge weekly gain.	Kinds and quantities of food consumed. Whole period.	Total cost of food.	Ave'ge weekly cost of food.
		Lbs.		*Lbs.*	*Lbs.*	*Quantities in pounds.*		
5	Gy.	129	May 8 to June 5, '97, 4	176	11.75	468 skim-milk, 14 flax-seed, 41 oats, 1 linseed, 18 hay	$1.90	$.475
7	J.	122	Oct. 16 to Nov. 13, '97, 4	170	12	392 skim-milk, 7 flax-seed, 45½ middlings, 2 linseed, 3½ hay	1.36	.34
8	J. G.	137	Oct. 30 to Nov. 27, '97, 4	185	12	896 skim-milk, 14 flax-seed, 126 middlings, 8 linseed, 126 hay	3.98	.995
9	D. G.	159		205	11.5			
10	A. & D.	176	Oct. 30 to Nov. 27, '97, 4	240	16	560 skim-milk, 7 flax-seed, 63 middlings, 4 linseed, 63 hay	2 21	.553
11	A.	165	Jan. 30 to Feb. 27, '98, 4	205	10	448 skim-milk, 2 flax-seed, 68 middlings, 49 hay	1.75	.437
12	J. G.	124	Jan. 30 to Feb. 27, '98, 4	171	11.75	448 skim-milk, 2 flax-seed, 19 middlings, 28 hay	1.25	.313
13	A.	126	Feb. 5 to March 5, '98, 4	165	9.75	448 skim-milk, 3 flax-seed, 25 middlings, 28 hay	1.33	.333

THIRTEEN TO TWENTY WEEKS OLD.

No. of calf.	Breed.	Weight at beginning.	Length of period, in w'ks.	Weight at end.	Ave'ge weekly gain.	Kinds and quantities of food consumed. Whole period.	Total cost of food.	Ave'ge weekly cost of food.
6	H. G.	201	July 31 to Aug. 28, '97, 4	213	10.5	504 skim-milk, 84 mixed grain, 84 hay	2.18	.545
7	J.	170	Nov. 13 to Dec. 25, '97, 6	232	10.3	616 skim-milk, 16 flax-seed, 47 middlings, 42 oatena, 6 linseed, 126 hay	3.10	.516
8	J. G.	185	Nov. 27, '97, to Jan. 8, '98, 6	245	10	1,344 skim-milk, 38½ flax-seed, 87 middlings, 84 oatena, 12 linseed, 252 hay	6.58	1.096
9	D. G.	205		268	10.5			
10	A. & D.	240	Nov. 27, '97, to Jan. 8, '98, 6	305	10.8	840 skim-milk, 17 flax-seed, 46 middlings, 42 oatena, 6 linseed, 126 hay	3.58	.596
11	A.	205	Feb. 27 to April 10, '98, 6	265	10	672 skim-milk, 7 flax-seed, 119 middlings, 140 hay	3.22	.536
12	J. G.	171	Feb. 27 to April 10, '98, 6	229	9.6	672 skim-milk, 7 flax-seed, 49 middlings, 168 hay	2.80	.466
13	A.	165	March 5 to April 9, '98, 5	210	9	560 skim-milk, 5 flax-seed, 53 middlings, 140 hay	2.40	.48

COST OF FEEDING CALVES.—FOUR TO EIGHT MONTHS OLD.

No. of calf.	Breed.	Weight at beginning.	Length of period in weeks.	Weight at end.	Ave'ge weekly gain.	Kinds and quantities of food consumed. Whole period.	Total cost of food.	Ave'ge weekly cost of food.
		Lbs.		*Lbs.*	*Lbs.*	*Quantities in pounds.*		
5	Gy.	312	Aug. 28 to Dec. 4, '97, 14.....	464	10.9	3,348 skim-milk, 818 mixed grain, 112 bran, 61 linseed, 762 hay.	$19.40	$1.385
6	H. G.	243		430	13.4			
7	J.	232	Dec. 25, '97, to Apr. 9, '98, 15.	375	9.5	1,680 skim-milk, 22 flax-seed, 233 middlings, 22 linseed, 567 hay	9.01	.60
8	J. G.	245	Jan. 8 to April 16, '98, 14.....	392	10.5	3,136 skim-milk, 31 flax-seed, 438 middlings, 32 linseed, 1,082 hay	16.59	1.185
9	D. G.	268		415	10.5			
10	A. & D.	305	Jan. 8 to April 16, '98, 14.....	475	12.1	1,960 skim-milk, 15 flax-seed, 219 middlings, 20 linseed, 541 hay	9.11	.65
EIGHT TO THIRTEEN MONTHS OLD.								
5	Gy.	464	Dec. 4, '97, to Apr. 16, '98, 19.	519	2.9	2,492 hay, 952 middlings, 112 oatena, 110 linseed.	22.17	1.166
6	H. G.	430		571	7.6			
THIRTEEN TO SIXTEEN MONTHS OLD.								
1	J. G.	570	Jan. 23 to April 16, '98, 12....	665	7.9	3,696 hay, 784 middlings, 490 bran, 70 oats, 56 linseed, 336 rowen.	31.26	2.605
2	J. G.	582		658	6.3			
3	A.	595		655	5.			
*4	J. G.	498		562	5.3			

*No. 4 was two months younger than the other heifers in the group.

SUMMARY OF TABLES

Eight calves under 5 weeks old. Average weekly gain 7.6 pounds. Average weekly cost 40.6 cents.

Eight calves from 5 to 9 weeks old. Average weekly gain 9.1 pounds. Average weekly cost 36 7 cents.

Eight calves from 9 to 13 weeks old. Average weekly gain 11.8 pounds. Average weekly cost 43.1 cents.

Eight calves from 13 to 20 weeks old. Average weekly gain 10 pounds. Average weekly cost 52.9 cents.

Six calves from 4 to 8 months old. Average weekly gain 11.1 pounds. Average weekly cost 63.7 cents.

Two calves from 8 to 13 months old. Average weekly gain 5.25 pounds. Average weekly cost 58.3 cents.

Four heifers from 13 to 16 months old. Average weekly gain 6.12 pounds. Average weekly cost 65.1 cents.

The heifers 1. 2, 3, and 4, were maintained on pasturage from July 24 until October 26, 1897, a period of 13 weeks and 2 days. The total gain in weight of the four animals was 313 pounds, or an average weekly gain of 5.9 pounds per head.

During the feeding periods recorded in the foregoing tables, comparisons were made between cooked, ground flax-seed. and cooked middlings as a substitute for the fat in milk, and also between rations including the cooked food and those without it.

In the first named trial, the calves were between 5 and 8 months old, and the middlings proved to be a satisfactory substitute for the ground flax-seed, the cost being less and the gain in weight large enough for the purpose though a little smaller than on the flax-seed.

The calves in the second trial mentioned were also over five months old. The substitution of the dry grain lessened the cost and the gain was sufficiently large, although smaller than in the previous period.

These trials show that for calves at the age of those described, there is no object in using anything but dry grain and hay along with the skim-milk, unless the greatest possible amount of growth is desired.

COMPARISON OF COOKED, GROUND FLAX-SEED WITH COOKED MIDDLINGS.

No. of Calf.	Breed.	Weight at beginning.	Length of period in days.	Weight at end.	Ave'ge weekly gain.	Kinds and quantities of food consumed.	Total cost of food.	Ave'ge weekly cost.
		Lbs.		*Lbs.*	*Lbs.*	*Quantities in pounds.*		
7	J.	212	Dec. 18, '97 to Jan. 22, '98, 35.	260	9.6	560 skim-milk, 17½ flax-seed, cooked, 70 middlings, 11 linseed, 105 hay	$2.91	$.582
8	J. G.	204	Dec. 18, '97 to Jan. 22, '98, 35.	265	12.2	1120 skim-milk, 35 flax-seed, cooked, 140 middlings, 10 linseed, 210 hay	5.67	1.134
9	D. G.	225	Dec. 18, '97 to Jan. 22, '98, 35.	277	10.4			
10	A. & D.	255	Dec. 18, '97 to Jan. 22, '98, 35.	328	14.6	700 skim-milk, 17½ flax-seed, cooked, 70 middlings, 11 linseed, 105 hay	3.19	.638
7		260	Jan. 22 to Feb. 19, '98, 28.	300	10	448 skim-milk, 14 middlings, cooked, 56 middlings, dry, 12 linseed, 105 hay	2.13	.532
8		265	Jan. 22 to Feb. 19, '98, 28.	305	10	896 skim-milk, 28 middlings, cooked, 112 middlings, dry, 28 linseed, 210 hay	4 31	1.078
9		277	Jan. 22 to Feb. 19, '98, 28.	315	9.5			
10		328	Jan. 22 to Feb. 19, '98, 28.	382	13.5	560 skim-milk, 11 middlings, cooked, 56 middlings, dry, 12 linseed, 105 hay	2.35	.588

COMPARISON OF RATIONS WITH AND WITHOUT COOKED FOOD.

No. of Calf.	Breed.	Weight at beginning.	Length of period in days.	Weight at end.	Ave'ge weekly gain.	Kinds and quantities of food consumed.	Total cost of food.	Ave'ge weekly cost.
4	J. G.	224	May 22 to June 26, '97, 35.	287	12.6	700 skim-milk, 18 flax-seed, cooked, 70 oats, 3 linseed, 42 hay	2.93	.586
5	Gy.	146	May 22 to June 26, '97, 35.	212	12.4	630 skim-milk, 18 flax-seed, cooked, 70 oats, 3 linseed, 42 hay	2.79	.558
10	A. & D.	382	Feb. 19 to Mar. 26, '98, 35.	443	12.2	700 skim-milk, 17½ flax-seed and middlings, cooked, 70 middlings, dry, 286 hay	3.74	.748
11	A.	190	Feb. 19 to Mar. 26, '98, 35.	250	12.	560 skim-milk, 17½ flax-seed and middlings, cooked, 70 middlings, dry, 126 hay	2.66	.532
12	J. G.	160	Feb. 19 to Mar. 26, '98, 35.	210	10.	560 skim-milk, 17½ flax-seed and middlings, cooked, 31½ middlings, dry, 126 hay	2.35	.47
4		287	June 26 to July 24, '97, 28.	333	11.5	560 skim-milk, 84 mixed grain, 46 hay, 7 oats, 48 green barley	2.24	.56
5		212	June 26 to July 24, '97, 28.	263	12.7	486 skim-milk, 84 mixed grain, 49 hay, 7 oats, 42 green barley	2.10	.525
10		443	Mar. 26 to Apr. 16, '98, 21.	475	10.7	420 skim-milk, 42 middlings, 168 hay	2 01	.67
11		250	Mar. 26 to Apr. 16, '98, 21.	277	9.	336 skim-milk, 70 middlings, 42 hay	1.44	.48
12		210	Mar. 26 to Apr. 16, '98, 21.	244	11.3	336 skim-milk, 21 middlings, 84 hay	1.26	.42

From the experiments reported by other American experiment stations, we have taken the results obtained with heifer calves, and calculated the cost of food on the basis of the New Hampshire schedule of prices.

The Massachusetts State Experiment Station in its Annual Report, for 1893, describes an experiment with various substitutes for milk-fat, while feeding skim-milk.

Four heifers in the lot were fed during an average period of 80 days, or up to the age of 12 weeks, on whole milk, skim-milk and a variety of grain mixtures. The average weekly gain for one calf was 9.7 lbs, and the average weekly cost of food would have been 41 cents. These results are very close to our own figures for calves of the same age.

The Iowa Experiment Station, in Bulletins 14 and 19, also reports results of feeding different grains with skim-milk. In Bulletin 14, two heifers between the ages of 6 weeks and 20 weeks, one a Shorthorn and the other a Holstein, in 13 weeks, consumed each, 1,456 lbs. skim milk, 127 lbs. flax-seed, 118 lbs. grain, consisting of ground oats, ground barley, corn meal, and bran, and 166.5 lbs. hay. The average weekly gain in weight for each calf was 12.7 lbs., and the average weekly cost of food on our basis would have been 68 cents.

In Bulletin 19, six heifers between the ages of 8 and 17 weeks, consumed in 60 days, an average per head of 1,200 lbs. skim-milk and 105 lbs. of grain, either linseed-meal, ground oats, or a mixture of corn-meal and ground flax-seed, 9 parts of the former to one part of the latter.

The average gain per week was 7.7 lbs. for each calf, and the average weekly cost of food would have been 41.5 cents.

The average gain for both lots would be 9 lbs. and the average cost per week would be 48.1 cents.

The average cost of our calves during this period was 45.4 cents per week.

The Minnesota Experiment Station, in Bulletin 35, gives results obtained with 8 heifer calves from two days old up to five and one-half months. The average feeding period occupied 21 weeks. The average quantity of food consumed by one calf during this period was 132 lbs. milk, 2,118 lbs. skim-milk, 18.4 lbs. bran, 16.6 lbs. flax-seed, 25.3 lbs. oats, 4.4 lbs.

corn meal, and 40.2 lbs. hay. These calves were carefully watched and closely fed so that no fattening occurred. The average weekly cost of food for each calf would have been on our basis. 32 cents, and the average weekly gain was 8.75 lbs.

For the period covered by these experiments the average weekly cost of our calves was approximately 44.2 cents, and the average weekly gain 9.5 lbs.

At the Kansas Experiment Station, as reported in Bulletin 72, the amounts of foods consumed by a number of young animals was carefully recorded during the winter months. Two Shorthorn heifers between the ages of 7 1-2 and 9 1-2 months, fed on hay, silage and grain, made an average weekly gain of 12.4 lbs. each, and the weekly cost of food would have been on our basis 44.5 cents.

Five heifers, one Hereford, and four Jerseys, fed on hay, grain, and a few mangels, between the ages of 11 and 16 months, made an average weekly gain of 9 lbs. each, and the weekly cost of their food would have been 58 cents per head.

The cost of our calves for a similar period was 65 cents per week.

The Wisconsin Experiment Station, in its annual Report for 1886, gives the results of feeding sixteen steers and heifers in one lot. These animals between the ages of 7 and 12 months, were fed for 18 weeks on hay, corn silage, corn stover, and grain, and during this period made an average weekly gain of 6.9 lbs. per head and the weekly cost of their food would have been 48.7 cents per week.

The cost of two heifers at our station for a similar period was 58 cents per week.

To ascertain the essential causes of the higher cost of our heifers when compared with the young stock fed in Kansas and Wisconsin, whose cost was calculated after our schedule, it was found that our older lot of heifers received an average per head of 4.1 lbs. grain and 11 lbs. hay, daily, while the five Kansas heifers received an average per head of 5.5 lbs. grain, and 4.9 lbs. hay, with a little silage and mangels.

The younger lot of our heifers received an average daily ration per head of 4.4 lbs. grain and 9.3 lbs. hay while the 16 Wisconsin animals received an average daily ration per head of 5.25 lbs. grain, 3.6 lbs. hay, 1.4 lbs. stover and 3.6 lbs. silage.

This comparison shows that our heifers were fed much more freely with hay than was necessary, which was due to the abundant crop that year. Were the schedule price of hay in this particular case, assumed to be the actual price of hay in the mow, at the time of feeding, the average cost per week would be much reduced.

The data at hand cover the period of sixteen months, and we think that a fair approximation to the actual cost of raising a heifer to that age can be calculated from them.

We will assume that a calf is dropped about October 1st.

For five months or 21 $\frac{2}{3}$ weeks, the cost according to our own data, would be 44.2 cents per week, or $9.57.

For the next three months or 13 weeks, our data would make the cost 63.7 cents per week or $8.28.

The pasture season would now be at hand and continue for five months, and the cost would vary with the location. The figures that we have obtained for calves, range between $1.50 and $2.50 for the season.

The remaining three months, would cost according to our data, 65.1 cents per week, or $8.46 for the 13 weeks. The total cost for the food consumed by the heifer during the 16 months would then be $28.81, and she should weigh from 600 to 700 lbs.

By closer feeding, as shown by the data from Kansas, Minnesota, and Wisconsin experiments, the cost should be reduced about 20 per cent., or to about $23.00.

In conclusion, a study of the tables will show that high-priced foods, viz., whole milk, flax-seed, linseed meal, and oats, will cause the cost of the weekly ration to increase out of proportion to the gain, if fed freely. Flax-seed cannot be used with economy except in the earliest stages of growth, the first two or three months, and whole milk should be discontinued as soon as possible.

The writer takes pleasure in acknowledging the assistance of Messrs. R. S. Alden, Leigh Hunt, E. H. Forristall, and H. A. Hanscom, who have at different times had charge of the work.

Bulletin 59 **November, 1898**

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

TENTH ANNUAL REPORT

BY CHARLES S. MURKLAND

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION.

Durham, N. H.

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CLEMENT S. MORRIS, *Clerk.*

* Resigned October 1, 1898.

† Resigned June 8, 1898.

TENTH ANNUAL REPORT.

The tenth annual report of the New Hampshire College Agricultural Experiment Station, for the year ending October 31, 1898, is herewith respectfully submitted. The reports of the department will be found upon the pages indicated in the following list:

Financial statement 169
Report of the Vice-Director 171
Department of Horticulture 176
Department of Agriculture 192
Department of Bacteriology 193
Department of Entomology 199
Department of Meteorology 215

Charles S. Murkland,
Acting Director.

ANNUAL STATEMENT

Of the Hatch Fund of the New Hampshire College of Agriculture and the Mechanic Arts, for the year ending June 30, 1898.

Receipts.

Cash received from United States treasurer	$15,000.00

Expenditures.

Cash paid for salaries	$8,148.88
labor	1,336.22
publications	976.20
postage and stationery	136.44
freight and express	79.19
heat, light, and water	981.33
chemical supplies	172.92

Cash paid for seeds, plants, and sundry supplies	$40.27	
fertilizers	217.80	
feeding stuffs	400.17	
library	401.45	
tools, implements, and machinery	310.64	
furniture and fixtures	66.43	
scientific apparatus	621.18	
live stock	32.60	
traveling expenses	261.38	
contingent expenses	75.77	
building and repairs	741.13	
		$15,000.00

SUPPLEMENTARY STATEMENT.

Receipts.

Cash received from the State Board of Agriculture for analysis of fertilizers	$627.00

Expenditures.

Cash paid for salaries	$286.45	
Balance	340.55	
		$627.00

We, the undersigned, duly authorized auditors of the corporation, do hereby certify that we have examined the books and accounts of the New Hampshire College Experiment Station for the fiscal year ending June 30, 1898; that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by us examined and found correct.

Also, that the receipts from fertilizer analyses have been duly expended and vouched for, as per supplementary statement.

And we further certify that the expenditures have been solely for the purposes set forth in the act of congress approved March 2, 1887.

(Signed)
JOHN G. TALLANT,
CHARLES S. MURKLAND,
Auditors.

Durham, N. H.

REPORT OF THE VICE-DIRECTOR.

To Charles S. Murkland, Acting Director:

The work of the Agricultural Experiment Station during the year ending October 31, 1898, has been conducted with no drawbacks excepting the wet spring season, which prevented the execution of some field experiments by delaying the preparation of the land until too late to secure satisfactory results.

Two important changes have been made in the policy and organization of the station.

At the beginning of the year, in accordance with the vote of the Board of Control, the college farm, herd, and creamery were made financially independent of the experiment station, while remaining under the same management as last year; and field experiments were limited to definite areas, instead of being conducted in every field that was tilled. By this means the items for labor, food-stuffs, and tools charged to the Hatch fund have been much reduced, while the supplementary statement no longer contains credits for farm produce sold.

On September 15, the Department of Agriculture and Horticulture was divided into two distinct departments, Professor Rane remaining at the head of the Department of Horticulture and Associate Professor Burkett assuming charge of the Department of Agriculture. The step is too recent to affect the work of this year.

The following changes have occurred in the staff of the station:

January 1, Mr. Ernest J. Riggs, B. S., of Ohio, was appointed assistant horticulturist, and continued in that position until June 8, when he resigned in order to return to Ohio.

July 1, Mr. Charles W. Burkett, M. S., of Ohio, was appointed assistant agriculturist, and on September 15 became head of his department.

October 1, Mr. Charles D. Howard, B. S., resigned his position as assistant chemist to accept a better position at the West Virginia Experiment Station.

Several important improvements have been made in the buildings, three fourths of the cost of which was borne by the farm. These improvements include stalls and pens for young cattle and calves in the new stable, a cement floor in the manure cellar under it, and a wash-room adjoining it. A small stable containing three stalls was fitted up in the old barn for experimental use.

The bulletins prepared during the year are as follows:

No. 49. Inspection of Fertilizers. By Fred W. Morse.

No. 50. Dehorning Cattle. By F. Wm. Rane and H. H. Lamson.

No. 51. Sweet Corn for New Hampshire. By F. Wm. Rane.

No. 52. Growing Muskmelons in the North. By F. Wm. Rane.

No. 53. The Farm Water Supply. By Fred W. Morse.

No. 54. The Winter Food of the Chickadee. By Clarence M. Weed.

No. 55. The Feeding Habits of the Chipping Sparrow. By Clarence M. Weed.

No. 56. Poisonous Properties of Wild Cherry Leaves. By Fred W. Morse and Charles D. Howard.

No. 57. Forage and Root Crops. By F. Wm. Rane.

No. 58. Cost of Raising Calves. By Fred W. Morse.

No. 59. Tenth Annual Report.

The reports of the different members of the Station Council are given in the succeeding pages.

During the year the Department of Chemistry has been assisted a portion of the time by Messrs. Charles W. Vickery, B. S., Arthur Given, B. S., and Harry E. Barnard, class of '99, N. H. C. It is the policy of this department to respond as promptly as possible to the applications from the public for analyses of fertilizers, and other substances pertaining to agriculture. This class of work and the fertilizer inspection for the State Board of Agriculture have required about one half of the department's time. Its scientific investigations have, therefore, been continued from year to year in order to obtain results that will justify a bulletin. Besides a report on fertilizer analyses, the department has issued a bulletin on the farm water supply, including observations made during several years, and one on the poisonous properties of wild cherry leaves, covering the work of two successive summers.

Respectfully submitted.

Fred W. Morse,
Vice-Director and Chemist.

PUBLICATIONS OF THE EXPERIMENT STATION.

During the ten years since its organization the New Hampshire College Agricultural Experiment Station has issued fifty-nine bulletins in regular series, six annual reports, and two special bulletins. Press bulletins have also been prepared for the use of the newspapers; but they are simply abstracts of the regular bulletins, and are not for general distribution, since they contain no new matter.

The list of regular bulletins is as follows:

No. 1. Ensilage.
No. 2. Feeding Experiments.
No. 3. When to Cut Corn for Ensilage.
No. 4. The Science and Practice of Stock-Feeding.
No. 5. Fertilizers and Fertilizing Materials.

No. 6. Experiments with Fertilizers.

No. 7. Test of Dairy Apparatus.

No. 8. Feeding Experiments. Part 1. Principles of Feeding. Part 2. Corn Meal, Middlings, Shorts, and Cotton-Seed compared.

No. 9. Effect of Food upon Milk.

No. 10. Co-operative Fertilizer Experiments.

No. 11. Pig Feeding. Part 1. Results of Feeding Skim Milk and Corn Meal versus Corn Meal and Middlings. Part 2. Digestion Experiment.

No. 12. Fertilizer Experiments.

No. 13. Part 1. Effect of Food on Butter. Part 2. Effect of Food on Quantity of Milk. (Out of print.)

No. 14. Ensilage in Dairy Farming.

No. 15. Patent Cattle Foods.

No. 16. Effect of Food on Composition of Butter Fat.

No. 17. Stock Feeders' Guide.

No. 18. Effect of Food on Milk.

No. 19. Spraying Apples and Pears against Fungi.

No. 20. Effect of Food on Milk. Feeding with Fats.

No. 21. Farm-yard Manures and Artificial Fertilizers.

No. 22. Prevention of Potato Blight.

No. 23. Some Dangerous Fruit Insects.

No. 24. The Flow of Maple Sap.

No. 25. The Composition of Maple Sap.

No. 26. Analyses of Fertilizers and Wood-Ashes.

No. 27. Spraying Experiments in 1894.

No. 28. Remedies for the Horn Fly.

No. 29. Remedies for Flea Beetles.

No. 30. An Experiment in Road Making.

No. 31. Seventh Annual Report. 1895.

No. 32. Studies of Maple Sap.

No. 33. Two Shade-Tree Pests.

No. 34. Surface and Sub-Irrigation out of Doors.

No. 35. The Codling Moth and the Apple Maggot.

No. 36. Analyses of Three Common Insecticides.

No. 37. Crimson Clover.

No. 38. The Tent Caterpillar.

No. 39. The Army Worm.

No. 40. Eighth Annual Report. 1896.

No. 41. Potatoes: Varieties, Fertilizers, Scab.

No. 42. Part 1. Tomato Growing in New Hampshire. Part 2. Notes on Tomato Breeding.

No. 43. Some Inferior Wood Ashes. Adulterated Paris Green.

No. 44. The Canker Worm.

No. 45. Fruit and Potato Diseases.

No. 46. Part 1. An Experiment with a Steam Drill. Part 2. Methods of Road Maintenance.

No. 47. Strawberries in New Hampshire. (Out of print.)

No. 48. Ninth Annual Report. 1897.

No. 49. The Inspection of Fertilizers in 1897.

No. 50. Dehorning Cattle.

No. 51. Sweet Corn for New Hampshire.

No. 52. Growing Muskmelons in the North.

No. 53. The Farm Water Supply.

No. 54. The Winter Food of the Chickadee.

No. 55. The Feeding Habits of the Chipping Sparrow.

No. 56. Poisonous Properties of Wild Cherry Leaves.

No. 57. Forage and Root Crops.

No. 58. Cost of Raising Calves.

No. 59. Tenth Annual Report. 1898.

It will be noticed that, beginning with 1895, the annual reports of the station have been issued as bulletins in the regular series. Previous to 1895, the annual reports were issued as Part II of the report of the college, and were numbered as follows:

First Annual Report. 1889.

Second Annual Report. 1890.

Third and Fourth Annual Reports. 1892.

Fifth Annual Report. 1893.

Sixth Annual Report. 1894.

The Third and Fourth Annual Reports are now out of print, but, aside from the financial statements, they contain no matter outside the regular bulletins, since they include only the bulletins issued during those years.

The two special bulletins issued were intended for local distribution, and contained merely an explanation of the weather signals displayed at the station.

DEPARTMENT OF AGRICULTURE AND HORTICULTURE.

The department remained the same as last year until September 15, when it was divided, and Mr. C. W. Burkett was promoted to take charge of the department of agriculture. This report as regards agriculture, therefore, ends upon September 15, last, while that of horticulture is given up to the present time.

The work during the past year has been mainly along agricultural lines. The results with various fodder crops, which have been grown the past three seasons, has been already published in Bulletin 57, and the reader is referred to it for these crops. A general study of rotations for the college farm has been outlined, and although it does not come directly under the head of experimental work, it is to a great degree of that nature. During the latter part of the year, the time of the head of the department has been taken up mainly in getting the agricultural work in shape, either for publication or to turn over to the new agriculturist. A few further experiments follow:

Destroying the Oxeye Daisy.

The oxeye daisy easily disseminates itself wherever farming is neglected. It can be kept from farms, however, if precaution is exercised. We have seen several farms in New Hampshire that are completely surrounded with this weed, but are kept absolutely free from it.

During the past few years the writer has had considerable experience in endeavoring to overcome this pest, in the course of which the following experiment was made. One method of keeping it from spreading commonly practised is to cut the hay early, and thus avoid the maturing of the seeds. In order to ascertain just how elastic this period might be, in July, 1897, a number of daisy blossoms were collected for study. The date of the opening of each blossom was noted, and specimens were taken at various periods from this time on.

The following tables show the results: Table I gives the date when the blossoms first opened and when they were collected, thus showing the number of days open. It also gives the number of seed tested for each period, and the number that germinated, thus showing the percentage of germination.

TABLE I.

No.	Opened.		Collected.		Days in bloom.		No. seed tested.	No. germinated.	Per ct. germ.
1	July	8	July	10	2	days.	730	....	....
2	"	8	"	13	5	"	730	....	....
3	"	8	"	14	6	"	780	....	....
4	"	8	"	16	8	"	930	....	....
5	"	20	"	29	9	"	930	....	....
6	"	20	"	30	10	"	380	....	....
7	"	8	"	20	12	"	1,030	7	.007
8	"	8	"	23	15	"	1,180	23	.020
9	"	8	"	28	20	"	930	28	.030
10	Dead ripe.	....			Unknown.		1,230	324	.260

Table II shows only the results of those which germinated, and the date and number of seed used at each test. These observations would lead us to believe that it takes at least twelve days for seed maturity of the daisy after it first blossoms.

TABLE II.

SEED TESTED.	No. 10.		No. 9.		No. 8.		No. 7.	
DATE.	Seed in test.	Germinated.	Seed in test.	Germinated.	Seed in test.	Germinated.	Seed in test.	Germinated.
October 18....	50	8	50	3	50	......	50	....
November 1....	20	2	20	....	20	....	20	....
December 6....	60	....	60	....	60	....	60	....
February 4	100	20	100	....	100	1	100	2
March 10....	200	8	200	2	200	1	200	....
April 15....	800	286	500	23	750	21	600	5
Total	1,230	324	930	28	1,180	23	1,030	7

Figure 1 is a photograph of a field adjoining the college farm, and represents the first growth from newly seeded ground. After the daisy matured there was such a good growth of timothy that the presence of the daisy could not be detected except upon close examination.

LIMING.

A number of experiments have been carried on to test the value of lime when applied to our soil.

Experiment 1. On July 9, 1896, we completed the preliminary work upon an old meadow. The field had been in grass for an indefinite number of years, and was practically exhausted. It was plowed up and staked off into plots, all of which were prepared alike. The plant food used was commercial fertilizer. Three series of plots of two each were used in the experiment, one in each being limed at the rate of one ton per acre, while the other was used as a check. The soil is a clay loam, rather low and not very well drained,—fairly representative of the grass lands in this section of the state. The following data show the results for the past two seasons, in each case on one acre of land.

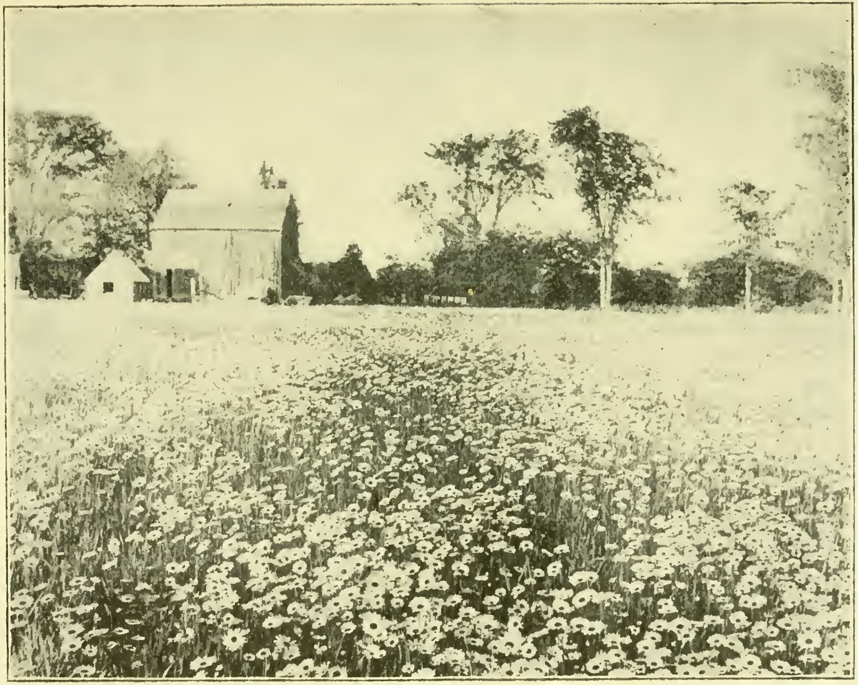

Fig. 1. — Daisies in newly seeded grass field. (Not on the College farm.)

Plot.	Kainit.	Acid phosphate.	Lime.	Yield per acre.		Two-year average.
				1897.	1898.	
1	800 lbs.	600 lbs.	....	3,480 lbs.	1,600 lbs.	2,540 lbs.
2	800 "	600 "	2,000 lbs	4,520 "	1,760 "	3,140 "
	Balance favor of lime			1,040 lbs.	160 lbs.	600 lbs.

Plot.	Muriate potash.	Acid phosphate.	Lime.	Yield per acre.		Two-year average.
				1897.	1898.	
3	200 lbs.	600 lbs.	....	3,360 lbs.	1,440 lbs.	2,400 lbs.
4	200 "	600 "	2,000 lbs.	4,440 "	2,080 "	3,260 "
	Balance favor lime			1,080 lbs.	640 lbs.	860 lbs.

Plot.	Muriate potash.	Acid phosphate.	Nitrate soda.	Lime.	Yield per acre.		Two-year average.
					1897.	1898.	
5	200 lbs.	600 lbs.	120 lbs.	....	3,800 lbs.	2,520 lbs.	3,160 lbs.
6	200 "	600 "	120 "	2,000 lbs.	4,280 "	2,520 "	3,400 "
	Balance favor of lime				480 lbs.	....	240 lbs.

From these results it is evident that the lime has been more effective in the first season's growth.

Experiment 2. This was an experiment with *versus* without lime, and was begun on potato land in the spring of 1896. As the season was unfavorable, and the tubers rotted badly, no notes were taken. The ground, which was a lightish loam, was plowed for the first time in a number of years. The following year the land was planted to the Leaming variety of ensilage corn, with the following results:

Ensilage corn with lime,	16,820 lbs. per acre.
Ensilage corn unlimed,	12,180 lbs. per acre.
Difference in favor of limed,	4,640 lbs. per acre.

This yield is low for either plot, but the facts that the land had been so shortly reclaimed, and that commercial fertilizers were depended upon entirely, no humus being added, account for it.

During the last cultivation of the corn, the land was seeded to clover and grass, to carry the experiment still another season. The weight of grass taken from these plots this season was, for the limed, 2,975 pounds, and for the unlimed, 2,660 pounds,—a difference of 315 pounds in favor of the limed land. The second crop was pastured, and therefore is not included in the above weights.

Experiment 3. This experiment was undertaken last spring through the assistance of two students in the Two Years' Course in Agriculture, Mr. C. W. Martin and Mr. G. H. Wheeler, to ascertain if the various fields of the college farm would be helped by liming. The work carried out in the main was to apply the tests recommended by Professor Wheeler of Rhode Island,* "How to Ascertain if a Soil will be Helped by Liming." The method, which is simple and should be understood by every one, is as follows:

"A tablespoonful or more of soil is placed in a tumbler or cup and moistened with sufficient water to make the mass of about the consistency of a thick paste. It is best to allow it to stand for from fifteen to twenty minutes before making the test, though it may be made at once. With a knife blade part the soil and introduce one end of a slip of *blue litmus paper,*† which may conveniently be one half to three quarters of an inch wide and two inches long, press the soil about the paper, and after from two to five minutes remove the paper without tearing it, rinse off the adhering soil with water and note whether it still retains a blue tint or has become positively red. If the paper has been strongly reddened, it may be concluded that lime will probably benefit many crops which may be grown upon the soil. If the soil has a marked reddish tint, as is sometimes the case, it may be better to bring but one side of the paper in contact with it, and if a red color comes through to the other side it may be concluded that the soil is acid. In all cases care must be taken not to handle the end of the paper which is used for making the test, since the touch of the fingers may redden it and thus one might be deceived.

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* Bulletin 46, R. I. Agricultural Experiment Station.

† A few cents will buy enough at any apothecary store to make many tests.

"In case a soil contains any considerable excess of carbonate of lime and magnesia, the humus is mostly combined with lime and magnesia, and in such a case if a teaspoonful of soil is stirred into a glass of water to which a few drops of *ammonia water** have been added, and the whole set aside for some hours, the liquid which remains at the top will be nearly colorless, but where lime and magnesia are lacking in a soil the liquid has usually a dark brown or black appearance, the intensity of color depending upon the amount of soil taken, and of course upon its need of lime."

The above instructions were carried out upon a number of fields by each student. In some cases where the ground is rolling and conditions vary, samples were taken, as, for example, from the high, medium, and low ground. Both tests were made, but upon compiling the notes, it was found that both the *litmus* and *ammonia water* tests practically showed the same results. Consequently, but one table is necessary.

Field.	Elevation of ground.		
	Low.	Medium.	High.
McDaniel	Decidedly acid	Acid	Neutral.
Creamery	Decidedly acid		
North	Decidedly acid		Acid.
Heater	Decidedly acid		Slightly acid.
Experiment	Slightly acid	Acid	
East of athletic ground	Decidedly acid		
Thompson	Decidedly acid		
Black swamp			Slightly acid.
Black swamp.... corn	Very slightly acid		Slightly acid.
+ Lime, 1,500 lbs. potatoes.	Very slightly acid		

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* This is to be had of any apothecary for a few cents.

SEEDING GRASS LANDS WITH *vs.* WITHOUT A NURSE CROP.

That grass lands can be seeded, when known to be perfectly free from weed seeds, without a nurse or protective crop, and with the best of results, there is no question. We quote from experiments carried on by Henry at the Wisconsin Experiment Station, in order to impress the importance of thorough cultivation as well as to show under what conditions success is assured.

* "1. The land must be quite free from weed seeds. If there are many weed seeds in the ground, these can be destroyed by summer-fallowing or by 'freshing' the ground several times before the grass seeds are sown. It positively will not do to sow grass where the ground is foul with weed seeds.

"2. The land should possess at least fair fertility in order to produce early springing and rapid growth of the young grass plants from the very beginning.

"3. The land must be very carefully prepared. In this there is nothing but gain to the husbandman by doing his work well. Every inch of the soil should be gone over again and again, and the surface rendered as smooth as a table and as fine as an onion bed. We have been very careless in the past in regard to the proper treatment of grass lands, and must improve in the future if we desire the heavy crops possible.

"4. It is well to sow large quantities of grass seed—two or three times the usual amount. In seeding, the field should be crossed both ways, if possible, so as to insure entire absence of skips or breaks in the evenness of the young sward.

"5. It is probably best, although we have not fully demonstrated the fact, to sow grass and clover seed very early in the spring time. Our returns for the present year, and those of some of our student correspondents, show the beneficial effects of very early seeding.

"6. Finally, a matter of much importance is that of checking the growth of weeds, which will annoy more or less in spite of all precautions. There being no grain crop to check

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* Thirteenth Annual Report Wis. Agricultural Experiment Station. 1896.

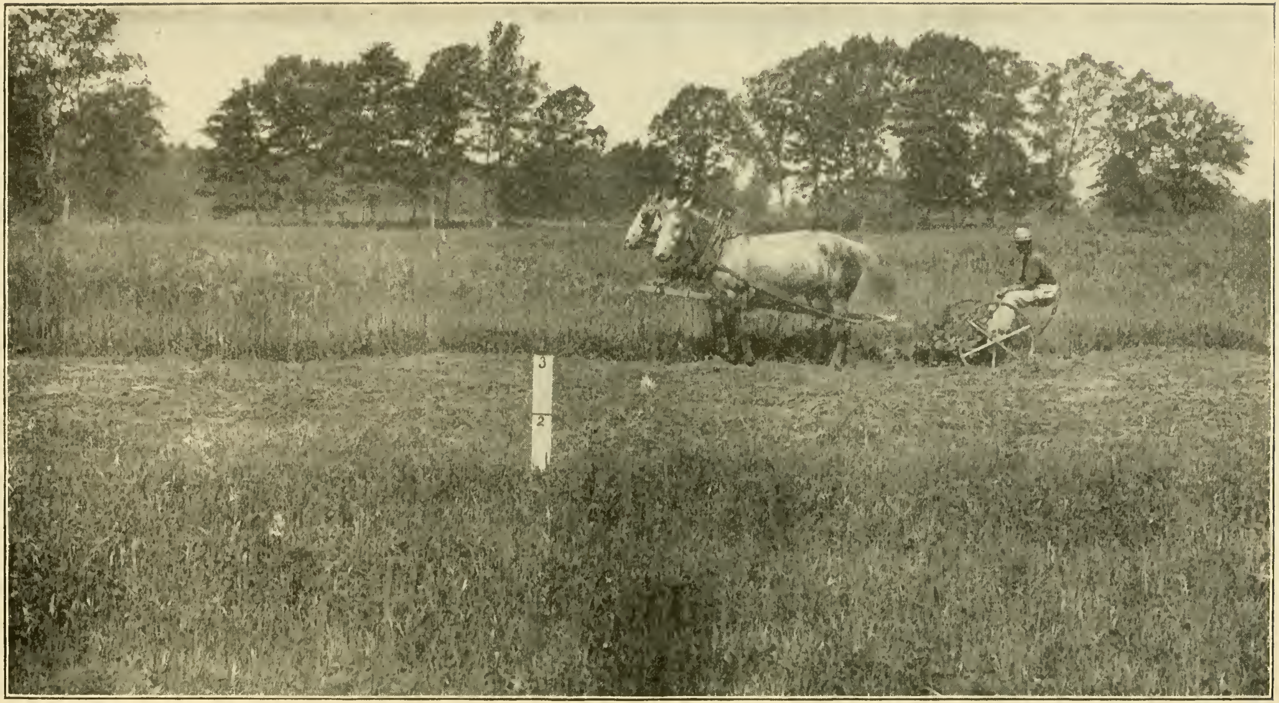

Fig. 2.—Seeding with *vs.* without a nurse crop. This side the measuring stake represents a strip seeded without, while that beyond is seeded with barley. First crop July 16th, 1897.

this growth, weeds luxuriate amazingly in the young seeding of grasses and clovers. When the weeds reach a height of six inches, the mower should be put into the field with the cutter bar set about four inches high. It is very light, rapid work trimming off the weeds, and the field is then most attractive in its even carpet of green. The young grass and clover plants are hurt far less by this mowing than are the weeds, and, their leaves shooting up, overtop the weeds, and hiding them from the sun choke them down. Sometimes, the mowing of the weeds must be repeated."

From the above it is readily seen that the average grass lands of New Hampshire, in order to produce a crop of grass and clover without a protective crop, must be judiciously handled.

An experiment was undertaken in the spring of 1897 on land that had been thoroughly cultivated with ensilage corn the two preceding years, and therefore was fairly clean. The ground was plowed and dressed with a fair coating of barnyard manure, supposed to be above the average as regards purity from weed seeds. It was worked in with a cutaway harrow. The soil was a heavy clay, but fairly well-drained, somewhat rolling; typical of the grass lands of this section. The following mixture of grass seed was used per acre: 5 pounds of alsike clover, 7 pounds choice red clover, 5 pounds of red-top and 12 of timothy or herd's-grass. A large plot of this, extending across the field, was staked off, and the remainder sown to barley, as a nurse crop, at the rate of three pecks per acre.

The season was favorable for grass, and on July 16, the barley was cut and cured for fodder. Figure 2 is a half-tone from a photograph taken on the above date, and shows the comparative heights of the two seedings. The measuring stake in the center of the photograph stands upon the dividing line of the two plots. The grass in the barley, as can be seen in the cut, had made an excellent growth, being a foot high and very heavy. The grass grown without the barley, as shown in the fore part of the photograph, was much smaller, and although the weeds were cut back once, was by no means so far advanced. The ragweed seemed to be the most troublesome in patches. The yield of barley and young grass in the first cutting was at the rate of 2 tons 372 pounds per acre when cured. The second crop from this same ground, which was clover, was cut during September, and put directly into the silo. This weighed in the green state at the rate of 3 tons, 1475 pounds per acre, or allowing fifteen per cent discount for curing, 3 tons, 353 pounds.

The plot without barley was cut on August 13, and yielded at the rate of 1 ton, 680 pounds of hay per acre. The true grasses were more in evidence in this plot, although there was a good catch of clover. The grass on the plot was not cut for a second crop.

During the present season it was found that the plot without the barley was the first to advance. It made a very rank growth. On June 1, the grass lodged badly, and was much heavier than the remainder of the field. It was cut on June 23, and the rate of yield for each per acre was as follows: For land stocked with barley, 2 tons, 1219 pounds, and for that without barley 4 tons, 1600 pounds. The second crop was pastured and no weights taken.

This experiment shows that although the crop with barley exceeded that without the first season, it came nearer being equal when extended over two years. Comparing the total weights for the two seasons the excess in favor of that with barley is 1 ton, 1662 pounds. I have no data to show whether if the experiment were continued longer, the plot without the nurse crop would fully equal the other or not.

An experiment was made by cutting a large strip across a newly seeded piece when the barley was but two thirds grown. This accomplished practically nothing, however, as the second crop of grass on this strip could not be distinguished from the rest of the field. The barley thus cut was used for soiling.

Last spring a number of plots were prepared for sowing various leguminous plants without a nurse crop. It so happened that the ground previously contained witch grass, which entirely choked out the various varieties of clover.

Conclusions:

1. Where it is positively known that the land is fertile and free from weed seeds, also that the fertilizer used is not contaminated, grass can be grown with success without a nurse crop.

2. Where barn-yard manures are used, or where the soil is not thoroughly cleansed of weeds, the nurse crop is an advantage in that it checks the weedy growth; also, if cut early for hay, as is common in New Hampshire, the grass has more time to develop, usually resulting in a good second crop.

3. It is but little more work to cut the nurse crop than under ordinary conditions it would be to cut the weeds. In the former case the green crop would compensate for the work.

4. The nurse crop takes nourishment from the soil that might otherwise go to the grass, but nothing is lost, as its value is realized from the crop itself.

5. Should the largest returns be expected the first season, or in case of a rotation in the earlier years of the rotation, it is better to use the nurse crop, unless the conditions are ideal for sowing grass seed by itself.

6. When witch grass is present it is practically impossible to get a fair catch of clover without a nurse crop.

7. From these experiments, taking everything into consideration, we believe that for our general New Hampshire conditions it is advisable to use the nurse or protective crop.

TOP-DRESSING GRASS LANDS.

In the spring of 1897 an experiment was carried on in top-dressing a field that apparently was about run out. The yield of hay would but pay for the labor. Two one-acre plots were selected, and one was dressed in the spring with the following mixture of fertilizers,—100 pounds of nitrate of soda, 100 pounds of dissolved bone black, and 50 pounds of muriate of potash. The other was utilized as a check.

The season was wet and very favorable for the grass crop. The yield from the fertilized plot was 3,840 pounds, and from the check plot, 2,930, making a difference in favor of the former of 910 pounds. These same plots were cut the present season without further treatment, giving 2,420 pounds from the fertilized plot, and 1,600 pounds from the other,—820 pounds in favor of the fertilized.

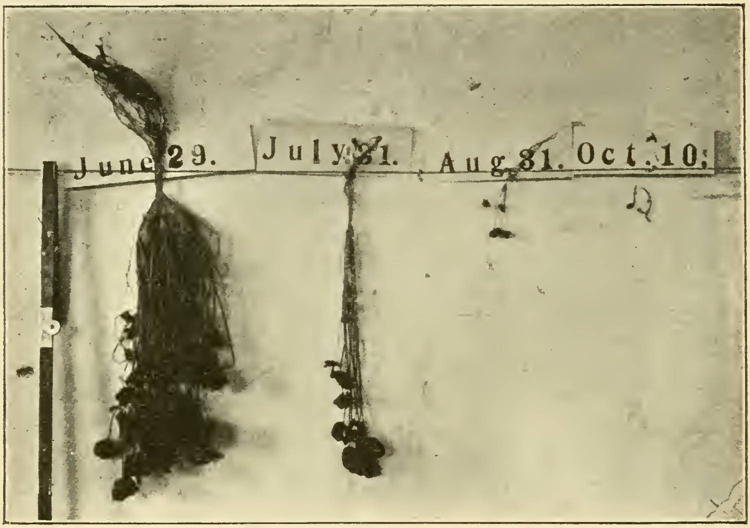

Fig. 3.—Crimson clover sown at different times throughout the season.

SOWING CRIMSON CLOVER IN DIFFERENT MONTHS.

An experiment has been conducted for studying the result upon this crop when planted at different times during the growing season. Sowings were made June 29, July 31, August 31, October 10, and November 6. In the late fall a representative specimen of each of the seedlings was photographed, as shown in Figure 3. From these it is seen that the plants attain a fair size when planted early. All were unable to withstand the winter climate. An occasional plant in each of the earlier sowings came through and blossomed.

As was shown in Bulletin No. 37 of this station, this is more proof that crimson clover does not withstand our winter climate. Its main value is in its growth of the first season, and it must therefore be considered as an annual with us. As a crop for seeding in fruit plantations, simply for the additional food value of the plantation and to keep the soil from washing during winter, it is valuable; but even here the seeding should be done early in August in order to obtain desirable results. Comparing crimson clover with the medium red variety, there seems to be little if any gain in its use. If the medium red and alsike are mixed, our experience shows that because of their ability to withstand the winters, while in all other respects they answer the same purpose, they are equally valuable if not more so.

THOMAS SLAG *vs.* REDONDITE AS A FERTILIZER.

A comparative test of these two phosphoric acid fertilizers was undertaken in the late spring of 1897, upon land seeded to grass. The nitrogenous and potash fertilizers were applied in equal quantities on both plots, and consisted of 80 pounds of nitrate of soda and 400 pounds of kainit per acre. The Thomas slag was used at the rate of 160 pounds per acre on plot 1. Plot 2 was equally divided. Raw redondite was used on one half at the rate of 80 pounds per acre, and roasted redondite at the rate of 40 pounds per acre on the other.

The barley used as a nurse crop was cut on September 7 with the following yields: Thomas slag plot, at the rate of 1,312 pounds, raw redondite, 1,520 pounds, and roasted redondite, 1,424 pounds per acre. The present season these same plots were weighed at haying time, with the following results: Thomas slag, 3,704 pounds, raw redondite, 4,320 pounds, and roasted redondite, 3,248 pounds per acre.

In each year, as is shown in the data, the raw redondite gave the greatest yield. Of the other two, the roasted redondite exceeded the Thomas slag by 112 pounds per acre in the first year, while in the present season it was reversed, the Thomas slag yielding 456 pounds per acre more than the other. From this experiment, therefore, their values are in the following order,—raw redondite, first; Thomas slag, second, and roasted redondite, third.

FRUIT CALENDAR FOR 1898.

On the whole this has been a fruit year. Doubtless other seasons have given larger yields of special kinds, as, for example, the over-abundant apple crop of 1896, the pear crop of last season, etc. However, taking into consideration fruits of all kinds from the apple to the smallest bush fruits, the season has been an ideal one in many respects.

The apple crop has varied in different sections, but in general has been productive. The fruit on the average is large, well-colored, and comparatively free from blemishes. Where 200 barrels were expected from the college farm, the yield was much nearer 300 barrels. The fall and summer fruit was very fine and productive, and brought good prices. It is a mistake not to market the fall apples, even though only a few trees are grown; if the fruit is well graded and nicely packed, it brings paying prices. Even the poorest apples, well sorted, netted us $1.50 per barrel this season.

When traveling in the northern part of the state the writer was completely surprised to find to what an extent the apple is grown. From Colebrook, Mr. Jordan has been shipping fall apples to Minneapolis and other places in the Northwest by the car-load, netting $1.75 per barrel. About Lancaster apples are doing well; at the State Grange fair at Tilton, J. D. Howe and Son of this place made a very fine display. All of the fruit in this northern section is highly colored and beautiful. Mr. Howe finds a home market for all he can raise. Another Lancaster man, Mr. B. C. Morse, agrees with Mr. Howe that they now have a winter apple that is destined to revolutionize the apple industry in this section. The variety is the Bethel. Its principal recommendations are its hardiness, flavor, and good keeping qualities. A description and figure of this fruit will be given in some future report.

This section is too far north for the Baldwin, which matures only under sheltered conditions. Mr. Howe sends me the following list of varieties, all of which, he says, do well with him. They are named in order of their ripening: Yellow Transparent, Tetofskey, White Astrachan, Red Astrachan, Peach, Duchess of Oldenburg, St. Lawrence, Alexander, Fall Jenetting, Fameuse, Wealthy, Nodhead, Porter, Tolman Sweet, Bethel, McIntosh Red, Twenty Ounce, Yellow Bellflower, Northern Spy, Stark, and Ben Davis.

Pears likewise do well in the northern section of the state, the following four varieties having been recommended: Flemish Beauty, Clapp's Favorite, Louise Bonne de Jersey, and Vermont Beauty; the last Mr. Morse claims is very fine.

Of plums Mr. Howe says the Bradshaw, Canada Egg, and Lombard are as good as any, but Moore's Arctic, Saratoga, Bonne Lee Anne, Green Gage, Chautauqua, Saunders, Abundance, and Damson all do well.

Mr. Morse reports that the three varieties of cherries, namely, the Ostheim, Early Richmond, and Nindswerth, are all valuable.

At the Bethlehem fair, the writer saw evidences of no little horticultural progress. The fruit displayed was very fine, and the outlook for this section, situated as it is in the White Mountains, is thought to be very bright. Those experienced say that no one has yet demonstrated the possibilities with fruits here. Small fruits are being raised more and more. One man, Mr. E. E. Bishop of Bethlehem, raised four acres of strawberries the past season. Formerly this fruit came chiefly from Boston gardeners.

In the central and southern parts of the state there was a very fair crop of peaches. Mr. George Tuttle of Barrington had a crop of over 1,000 baskets, all of which were very fine. The orchard of Mr. Stratton in Hollis, which he reported last year, gave a crop this year almost as fine as that of last season. The main varieties used by both of these men are Mountain Rose and Early Crawford. Mr. Tuttle raises some Fosters and Wheatlands which he values highly. The peach rot has been very troublesome during the past season. Strawberries have been over-abundant in some markets this year. Red raspberries seemed to be scarce and brought good prices.

The main lines in horticultural work at the station during the year have been with potatoes, muskmelons, and strawberries. Much work of an experimental nature has been done in the greenhouses, all of which will be published in bulletin form.

F. Wm. Rane,
Horticulturist.

DEPARTMENT OF AGRICULTURE.

The College Herd.

The college dairy herd at present is composed of sixteen Jerseys, six pure bred and ten grades; seven Ayrshires; five Guernseys; three grade Durhams; and two grade Holsteins.

HERD RECORD FROM NOVEMBER 1, 1897, TO OCTOBER 30, 1898

Month.	Milch cows.	Dry cows.	Pounds of milk.	Average for each milch cow.	Average for herd.	Average fat test.	Pounds of butter.
November	27	9	13,854	513	385	4.7	756.73
December......	28	8	15,812	564	439	4.6	841.43
January	25	9	15,167	606	446	4.6	800.90
February	26	7	13,780	530	417	4.6	745.76
March	25	8	15,014	577	455	4.5	897.32
April	23	10	13,536	588	410	4.57	710.18
May	26	7	15,862	610	480	4.4	800.33
June	26	7	16,414	631	497	4.4	871.78
July	28	5	16,322	563	494	4.6	875.94
August	27	6	12,609	467	382	4.75	698.47
September	25	8	12,713	508	385	4.6	682.25
October	23	10	11,928	562	362	5.0	695.80

The herd has been equivalent to 309 milch cows and 94 dry cows for one month and has produced 173,011 pounds of milk and 9,376.89 pounds of butter, making an average monthly yield per head for 403 cows, 429 pounds of milk and 23.3 pounds of butter, or 5,148 pounds of milk and 280 pounds of butter for the year. The data have been taken from the daily and weekly records of the barn and creamery, and the butter calculated by the standard formula, butter $= 1 + \frac{1}{6}$ fat instead of the actual weights obtained, since the latter would involve corrections for cream and milk sold.

The work of this department during the past year was connected with that of the department of horticulture, and the record of the work is given in the report of the horticulturist.

Charles W. Burkett,
Agriculturist.

DEPARTMENT OF BACTERIOLOGY.

The work of this department during the past year has been chiefly a continuation of various lines of investigation previously begun, viz., dairy bacteriology; the study of the root tubercles of the leguminous plants, both wild and cultivated; study of the life history and treatment of black knot of plum and cherry, and the fungous diseases of the apple. Experiments in the measurement of temperatures by electrical means, and in the bacteriology of ensilage have been begun.

Edible Mushrooms.

For some time in different quarters there have been signs of an awakening interest in the study of mushrooms, especially with a view to their use as food. The writer has for several years been interested in their study from a botanical point of view, and it seems to him worth while to call the attention of those whom this report is likely to reach to some of the facts in regard to them.

Mushrooms are not only palatable but many are to be considered as delicacies. Mushrooms are nutritious, being comparable in this respect to the meats. Mushrooms at certain seasons are very abundant. In spite of these facts comparatively few people in this country make use of the wild species for food. This is undoubtedly due to the fact that it is known that some varieties are exceedingly poisonous. Therefore, those who do not know anything about the different kinds do well to let them all alone. There is, however, no good reason why persons who will take a little pains to become acquainted with these plants should not be able to avoid the dangerous ones and to enjoy the edible ones. It is the object of this paper to call attention to the poisonous ones, rather than to point out the harmless ones. For the former are comparatively few, and being once known so as to be avoided a great part of the danger of mushroom eating is removed.

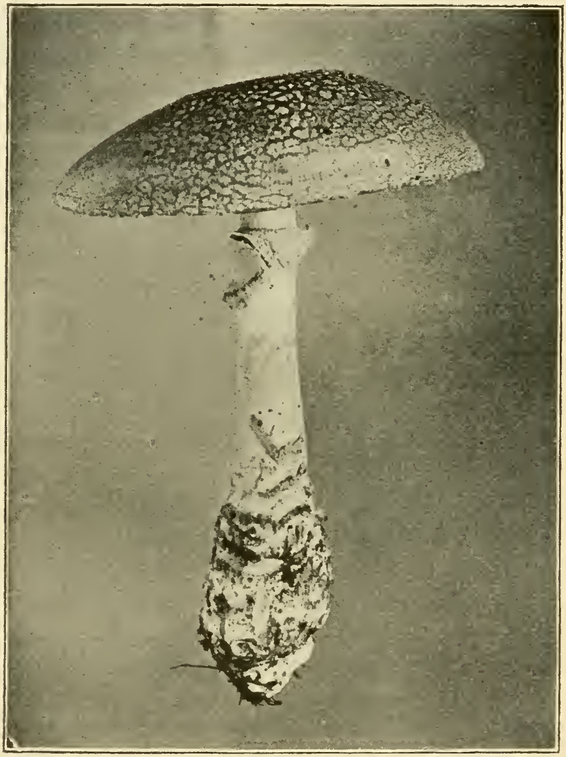

Fig. 4.—Fly Agaric. Poisonous.

According to popular belief, mushrooms are edible and toadstools are poisonous; the botanist calls them all mushrooms, but recognizes the fact that some are poisonous and others are not, just as is the case with higher plants. Mushrooms belong to that great class of plants known as fungi, which differ from ordinary plants in their shape, color, and mode of life. They consist of a vegetative part and a reproductive part. The vegetative part is usually inconspicuous and simple in structure, consisting of a mold-like mass of minute colorless threads known as the mycelium, which grows on decomposing vegetable matter on the surface of the soil or on dead trees. The reproductive part is by far the largest and most conspicuous part, and is what is commonly called the mushroom. It assumes various forms, the most common of which is the familiar umbrella shaped structure consisting of a *stem*, and an expanded portion called the *pileus* or *cap*. The under side of the cap is covered either with thin radiating plates called *gills*, or with minute closely packed tubes or *pores*. On the surfaces of the gills or in the cavity of the pores the reproductive bodies or *spores* are borne. In some species in the young state the gills or pores are covered by a membrane known as the *veil*. As the mushroom develops this becomes detached from the circumference of the cap and may either fall off or remain attached to the stalk, when it is known as the *ring*. In some species, when very young, the whole mushroom is inclosed in a membrane called the *volva*; this is soon torn apart but traces of it may remain even in the mature state as wart-like projections on the cap or as a cup-like structure on the base of the stem, out of which the stem grows as from a socket. This cup is a mark of the highest importance in distinguishing the dangerous varieties. Poisonous mushrooms may be divided into two classes: those which are deadly and those which only produce nausea or some other digestive disturbance, but are not usually fatal. It is believed by authorities that all of the deadly varieties show the cup in some form at the base of the stem. If, therefore, one becomes familiar with its appearance, and is able to detect it, he will be able to avoid the chief dangers of poisoning.

At least two of the deadly varieties are common in New

Hampshire. They both usually grow either in the woods or at the border of woods or thickets. One is almost pure white, with a smooth cap, or possibly warty when young, and certainly presents a most innocent appearance; but at the base of the stem, usually concealed in the decaying vegetable matter in which it grows, is to be found the well marked cup which is the sign of warning which must not be disregarded; it is deadly poison. Here is to be noted a precaution which should never be neglected in collecting mushrooms for eating purposes: *Never break off* the mushroom, but, so to speak, dig

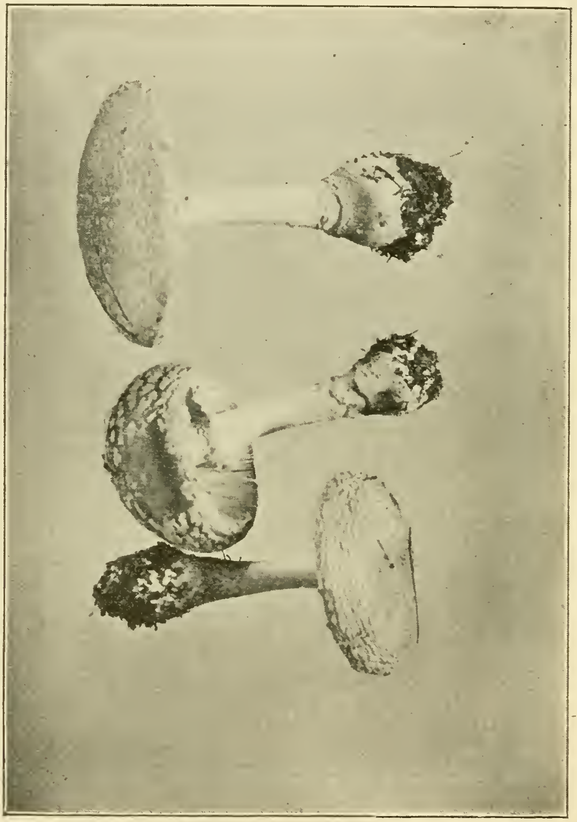

Fig. 5.— Fly Agaric. Poisonous.

it up by the root; for only by so doing can one be certain that there is not a warning cup at the bottom of the stem.

One of the largest, handsomest, and in the latter part of the summer and fall, one of the commonest mushrooms is the *Agaricus muscarius* or "fly agaric," so called from its sometime use as a fly poison. It varies greatly in size and color; the stem is from three to seven inches in length; the cap has about the same range of diameter. The upper surface of the cap varies in color from almost white through yellow to orange or scarlet; it is studded more or less thickly with warty scales of a light color, the remnants of the volva. The gills are white, as is also the stem. The cup is present, but usually it is not so distinct as in the above-mentioned species. The lower part of the stem is more or less swollen or bulbous, the upper part of the bulbous portion being covered by a ragged surface sometimes showing a well marked ring corresponding to the margin of the cup, sometimes showing several rings, perhaps incomplete, one above the other. This mushroom is also deadly poison. Figures 4 and 5 show specimens. Figure 6 shows three young specimens which have but just broken out of the volva, the remains of which are seen on the unexpanded cap and on the bulbous base of the stem.

All mushrooms with a cup or the suspicion of a cup should be rejected.

None of the others are considered dangerous to life, although they may produce unpleasant symptoms. The possession of harmful properties is usually accompanied by a bitter, acrid, peppery, or otherwise unpleasant taste; all such should be rejected. If the mushroom is without a cup it should be tasted; if it is tender and pleasant to the taste the probability is that it is not poisonous. Mushrooms should be gathered and eaten when fresh, as they soon become infested with insects and begin to decay.

In testing the edible properties of an unfamiliar species it is well to begin with a small portion, gradually increasing the amount if no unpleasant symptoms follow the first trials.

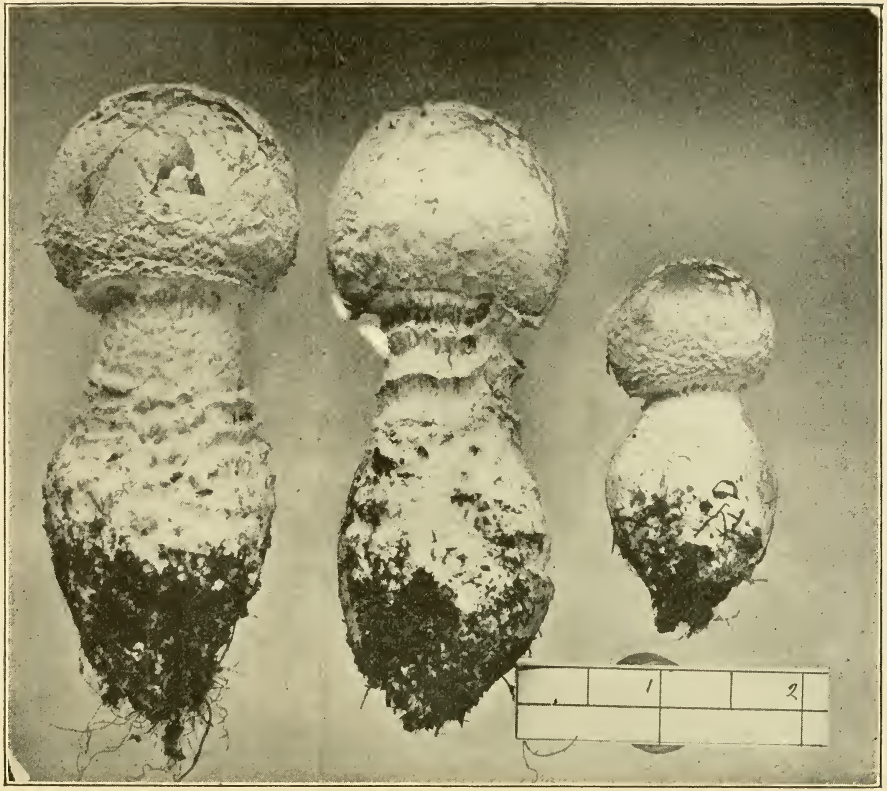

Fig. 6.—Fly Agaric, young. Poisonous.

Dr. W. G. Farlow, in Bulletin 15, United States Department of Agriculture, gives the following rules:

"1. Avoid fungi in the button or unexpanded stage; also, those in which the flesh has begun to decay, even if only slightly. 2. Avoid all fungi which have stalks with a swollen base surrounded by a sac-like or scaly envelop, especially if the gills are white. 3. Avoid fungi having a milky juice, unless the milk is reddish. 4. Avoid fungi in which the cap or pileus is thin in proportion to the gills, and in which the gills are nearly all of equal length, especially if the pileus is bright colored. 5. Avoid all tube-bearing fungi in which the flesh changes color when cut or broken, or where the mouths of the tubes are reddish, and in the case of other tube-bearing fungi experiment with caution. 6. Fungi which have a sort of spider-web or flocculent ring around the upper part of the stalk should in general be avoided."

H. H. Lamson,
Bacteriologist.

DEPARTMENT OF ENTOMOLOGY.

During the past year the work of the department of entomology has consisted of studies of the life histories of various injurious insects and the methods of controlling them, of an investigation of the food relations of certain birds, especially the chickadee and the chipping sparrow, and of experiments with various insecticides. In addition the formation of a collection of New Hampshire insects has been continued, and the inquiries of many correspondents have been answered. The more important entomological events of the year are mentioned in the following Insect Record, although we have studied several insects not there included. In nearly all this work efficient aid has been rendered by Mr. W. F. Fiske, assistant entomologist.

The Insect Record for 1898.

Much the most important item in the record of insect injury for the year in New Hampshire is that of an exceedingly destructive outbreak of the FOREST TENT CATERPILLAR (*Clisiocampa disstria*), which extended over a large part of the state. This was a continuance of the irruption of this insect noted in the insect record for 1897,* although as was to be expected the outbreak this year was more serious and extended over a wider area. The caterpillars were most abundant in the western part of the state, especially in the Connecticut valley, where extensive forest areas were defoliated by them. For, unlike the common AMERICAN TENT CATERPILLAR (*Clisiocampa americana*), this forest species does not as a rule confine its attack to three or four sorts of trees, but feeds upon the foliage of nearly all deciduous species. The nearly full grown caterpillar is represented in Fig. 7. As will be seen by comparing this picture with Fig. 8, which represents the American Tent Caterpillar, the two species are similar; but they may easily be distinguished by the differences in the markings of the line along the middle of the back. In the forest caterpillars this line is interrupted, consisting of a series of markings like that shown in the middle of Fig. 7 *a*, while in the common tent caterpillar the line along the middle of the back is continuous.

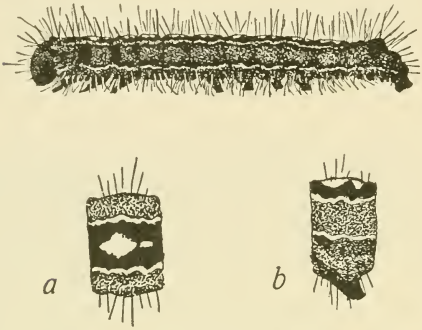

Fig. 7.—The Forest Tent Caterpillar : *a*, markings on one ring of the back; *b*, markings on one ring of the side.

These caterpillars have attacked nearly all kinds of deciduous trees, causing special damage to shade trees like the elm and maple. Many sugar orchards appear to have sustained injury that will lessen their productiveness in the immediate future. As a rule, the attack appears to have been more severe in the towns and villages than in the country. These larvæ hatch from the eggs a week or more later than the common American tent caterpillars, and there is considerable variation in the time of hatching within the species itself. In a given region caterpillars of various sizes could easily be found late in May or early in June. They feed upon the leaves in all parts of the trees, having a preference apparently for the upper branches. They very commonly eat out the blade of the leaf along the side of the midrib, severing the marginal part so that it falls off; these severed portions were to be found abundantly on the ground beneath the infested trees. The result of this peculiar mode of attack is of course greatly to increase the damage done for the amount of leafage actually consumed. A bulletin giving a full discussion of the life history and remedies for the forest tent caterpillar, is in preparation for publication before next spring.

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* Bulletin 48, p. 142.

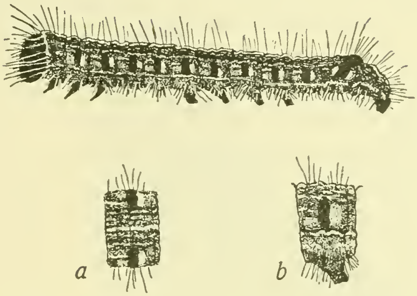

Fig. 8.—The American Tent Caterpillar: *a*, markings on one ring of the back; *b*, markings on one ring of the side.

A more encouraging statement may be made concerning the AMERICAN TENT CATERPILLARS (*Clisiocampa americana*) which have been regularly destructive for several seasons past, for in some localities at least there are indications that they will be less abundant next year. In the region about Durham there were heavy and long continued rains during the time when the caterpillars were hatching from the eggs and before they had time to spin for themselves a protecting web. The result was that a large proportion of the young larvæ were washed away or destroyed. As a rule only those survived which were able to shelter themselves on the under surface of the twig to which the egg mass was attached. Consequently, at the beginning of the season there was a considerable reduction in the numbers of the caterpillars. The survivors, however, developed in sufficient abundance to be decidedly in evidence in May, but during the last weeks of their growth there appeared among them a bacterial disease, a sort of insect cholera, which killed them in vast numbers. The effectiveness of this disease was doubtless increased by the wet weather prevailing at the time. Early in June nearly every nest was full of the dead and dying caterpillars, those upon the outside of the web hanging limp and lifeless at first (Fig. 9), and then gradually shriveling up until only the dried skins told of their presence. A series of observations made upon a large number of nests just before the period of pupa-

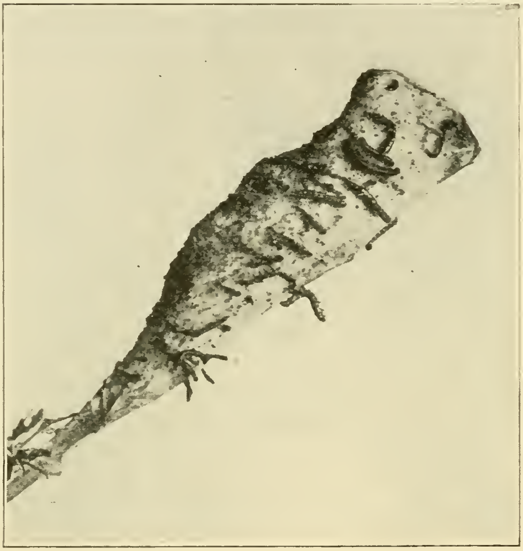

Fig. 9.—American Tent Caterpillars killed by disease.

tion showed that more than ninety per cent of the caterpillars present had been killed by this disease. As a result there were few caterpillars crawling along the roads in early June. although during previous seasons great numbers were to be seen at that time. There were also comparatively few moths to be found later, and the egg masses of the next year's brood are correspondingly reduced in numbers, although there are still enough of these eggs upon the trees to yield a goodly crop of caterpillars next season.

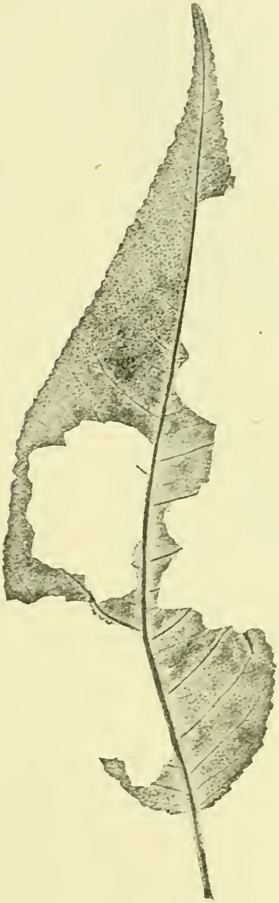
Fig. 10.— Leaf of Black Cherry eaten by Forest Tent Caterpillar.

We tried many experiments with remedies for the American Tent Caterpillar, although but little new information was brought out. The careful use of a small amount of kerosene, a teaspoonful to a nest, in wetting the silk of the tent, was found a satisfactory way of killing the partially grown caterpillars. But great care is necessary, as, if sufficient kerosene is added to saturate the bark, the tree is injured. If the web away from the bark is lightly dampened the caterpillars come in contact with it as they pass in and out of the nest and are killed.

One of the most satisfactory remedial measures for these tent caterpillars that has come to my notice related to the removal of the egg masses. In Newfields, N. H., the Village Improvement Society offered the children in the schools ten cents a hundred for all the egg masses or "caterpillar belts," as they were aptly called, brought in. Many of the children worked faithfully, and when, in February, the writer was called in to point the moral of the lesson, 8,250 egg masses were shown as the result of their endeavors. I doubt if the expenditure of $8.25 by a village improvement society often does more good than was done in this case. The caterpillars were destroyed, the effect being easily noticeable in the spring and early summer, while the boys and girls had a remarkable lesson in nature study.

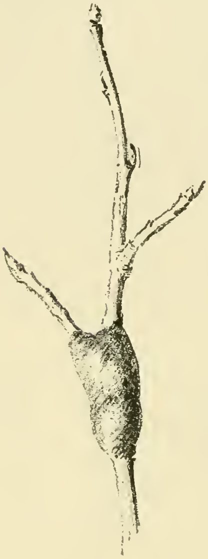
Fig. 11.—Egg-mass of American Tent Caterpillar.

Several complaints reached the station during the summer concerning black spiny caterpillars that fed in colonies on the elm trees, often defoliating good sized branches. Whenever specimens accompanied the complaint, the insect proved to be the larvæ or caterpillars of the ANTIOPA BUTTERFLY (*Euvanessa antiopa*), a species which is more or less abundant every season. These butterflies are justly regarded as among the most beautiful of our insects; the wings are a rich purplish black color with a creamy border running along the outer margin. They may be found late in autumn or early in spring flying by the roadside or in open glades in the woods; and occasionally during the intervening months one who looks beneath culverts or bridges, or in some loose pile of boards, will come across one of these butterflies passing the winter in a situation where it is exposed to the lowest temperatures. If in cold weather such a butterfly be brought into a warm room it will gradually become active. In spring eggs are laid by the females in clusters upon the twigs of elm, willow, and poplar trees, the eggs soon hatching into caterpillars that feed upon the foliage. The caterpillars remain together more or less as a colony, so that their presence is soon indicated by the bare twigs that they leave behind them. When they become full grown, they seek shelter of some sort, where each changes to a chrysalis, to emerge soon afterward as a fully developed butterfly. There are two broods each season.

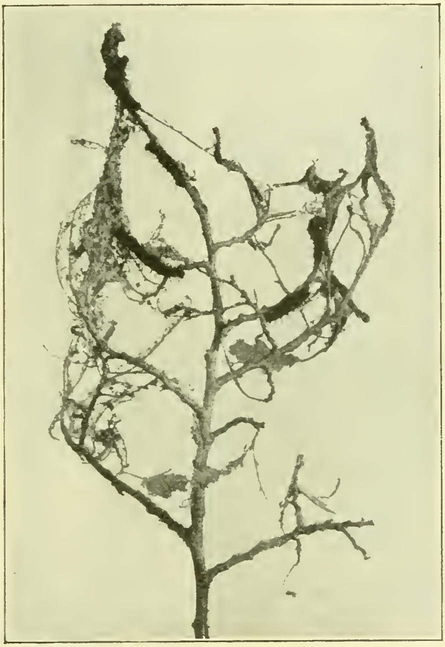

Fig. 12.— Elm twig showing work of Antiopa Caterpillars.

These colonies of caterpillars are usually so conspicuous that it is an easy matter to cut off the branch on which they are feeding, and to crush them. Some of the caterpillars, the defoliated twig, and the slight silken web they make while they are at work are represented in Fig. 12.

Another insect attacking fruit and shade trees, which was extraordinarily abundant this year, was the FALL WEB WORM (*Hyphantria cunea*). The unsightly webs of these caterpillars, during the late summer and early autumn, festooned a large proportion of the orchard trees in southern New Hampshire. To many young trees these caterpillars must have caused serious injury. In another place* I have summarized the life history of this species, as follows:—The adult is a pretty white moth which deposits eggs on the leaves of various trees early in summer. These soon hatch into young caterpillars that begin at once to spin a protective web. The young worms are of a pale yellow color, sparsely clothed with hairs, and have a black head and two rows of black marks upon the body. They feed upon the parenchyma of the foliage, leaving the network of veins, and grow quite rapidly, enlarging the web as they develop. By the time they are full grown a single colony of them will destroy the foliage of a good sized branch, making it very conspicuous on account of the web-like covering. At this time the larvæ are a little more than an inch long, with the body densely clothed with yellowish hairs. They now leave their nests and descend to the ground, where just beneath the surface, or under some suitable shelter above the surface they spin slight silken cocoons, within which they change to the chrysalis state. At the north there is but one brood each year, but in the southern states there are two.

The webs of this insect are so conspicuous that it is an easy matter to cut them off and burn or crush the larvæ. This is a simple remedy, and the earlier that it is done the better. A little careful work in removing these webs when they first appear early in August will greatly improve the looks of the orchard, as well as increase its productiveness in following seasons. The caterpillars are then clustered together on one or two twigs, and may readily be crushed or burned.

Early in September there appeared in the vicinity of Durham an incipient outbreak of an insect that may be called the RED-HUMPED OAK CATERPILLAR, as it has not heretofore received a common name. In entomological literature it has generally been known by its scientific name, *Edema albifrons*,† although it has been so rarely destructive that the necessity

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* Insects and Insecticides, p. 201.

† This species has lately been placed in the genus *Symmerista*, and technically it is now called *Symmerista albifrons*.

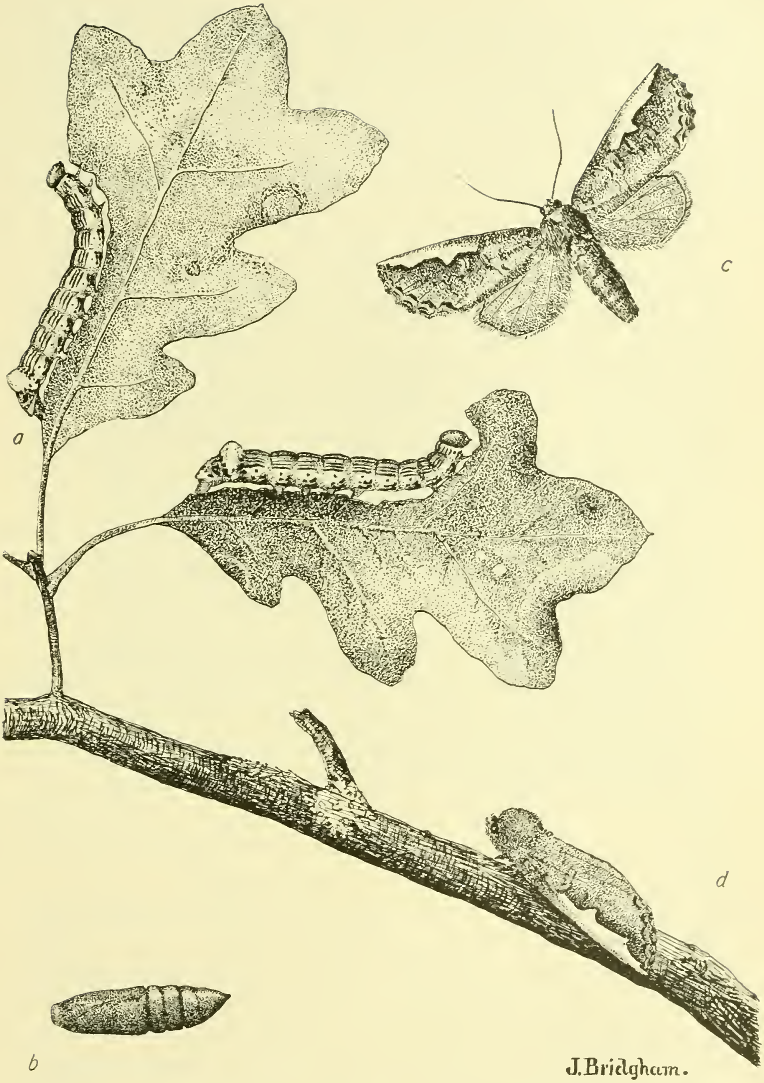

Plate I.—The Red-humped Oak Caterpillar: *a*, larva; *b*, pupa; *c*, moth, wings expanded; *d*, moth at rest.

for a common name has not been recognized. When full grown this caterpillar is nearly two inches long, and of the general form represented in *a* of Plate I; the head is reddish brown, while the body is striped longitudinally with black, yellow, and whitish. Near the hind end there is a prominent reddish hump, the presence of which has led to the proposal of the common name mentioned above.

These caterpillars feed upon the leaves of the various species of oak, eating the blades and leaving the midribs. In this process good sized pieces of the leaves are commonly detached to fall to the ground, where they were very abundant in the infested woods. When the caterpillars become full grown—from the middle to the last of September—they descend to the ground, where beneath the fallen leaves they pupate in a slight cocoon. The pupa is brown, and of the shape represented in Fig. *b* of the plate. The following spring the pupæ develop into greyish moths, similar to the one represented in *c*. These moths rest during the day upon oak twigs, being rendered inconspicuous by their resemblance to a growth on the twig.

These red-humped oak caterpillars are seldom injurious. One reason for this is to be found in the fact that they are greedily devoured by the common ruffed grouse or partridge, which frequents the open woods where the caterpillars occur. In a study of the food of this bird the present season, Mr. Ned Dearborn of this college has found that a large part of the food in September consisted of these caterpillars, as many as sixteen of them being found in a single stomach.

During the early summer inquiry was repeatedly made concerning two of our largest and most beautiful moths, which seemed either to be unusually abundant, or else to attract more than ordinary attention. The first of these is the large dark brown moth, the side view of which is represented in Fig. 13. When its wings are spread they commonly expand about five inches from tip to tip, the body of the insect being nearly an inch and a half long. On the front end of the body are two large feathery feelers or antennæ. On each of the wings near the middle there is a whitish or brownish crescent-like spot, while a wavy line, similar in coloration, runs along each wing nearly parallel with the outer margin and about three fourths of an inch from it. Near the tip of each front wing there is an oval black spot with a small white crescent on its inner edge. The body is of a brick red color, with rings of white and dark brown on each segment of the abdomen.

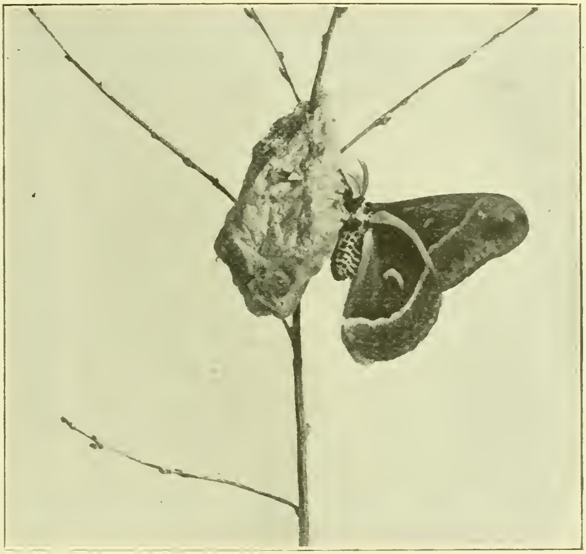

Fig. 13.—The Cecropia Moth and its Cocoon (reduced).

This moth, which is called the CECROPIA MOTH, being known to science as *Samia cecropia*, emerges from a large silken cocoon, like that shown in Fig. 13. These cocoons may be found in winter upon a variety of trees and shrubs; if brought in doors and kept in a cool room, they will yield the moth in the early summer. When at liberty these moths deposit their eggs on many sorts of fruit, forest, and shade trees, the eggs hatching into caterpillars that feed upon the foliage of the tree. The caterpillars grow during the summer, and early in autumn spin the large loose silken cocoons, within which they change to pupæ to remain throughout the winter. In New England this species is seldom if ever sufficiently abundant to do serious injury.

The other moth referred to above may fairly claim to be our most beautiful insect. By the great Linnæus it was named the LUNA MOTH (*Actias luna*), and has long been known as the Queen of Night. Its general appearance is well shown in the photograph reproduced in Fig. 14, the wings expanding fully four inches, and the colors being a delicate green margined with greenish yellow along the posterior edges, and a delicate purplish brown along the front border. This species also appears in early summer, occasionally flying at night into open windows of lighted rooms, where its size and beauty are sure to attract attention. Its life history is quite similar to that of the Cecropia moth. The eggs are deposited on the leaves of various trees; the caterpillars feed upon the foliage, and late in summer or early in autumn spin their

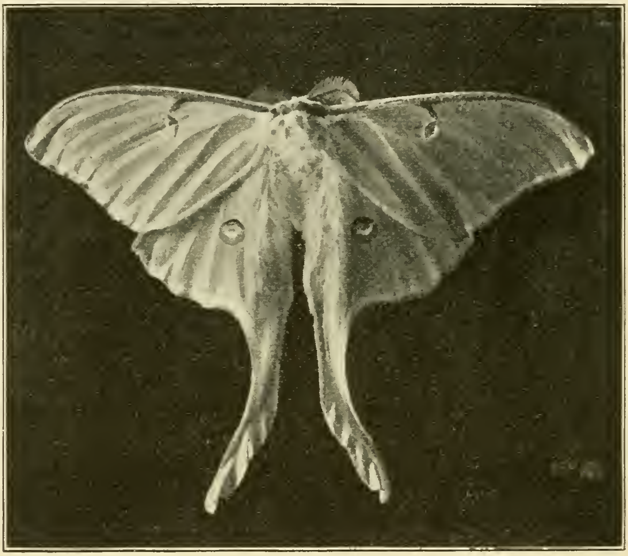

Fig. 14.— The Luna Moth (slightly reduced).

tough, oval, silken cocoons on the ground beneath their host plant. There they remain until the warmth of the succeeding spring calls them to life, when they come from the cocoons as marvels of insect beauty. The caterpillars are seldom seen, and in New England at least they are never destructive to a serious extent.

The ROSE BEETLE (*Macrodactylus subspinosus*), or ROSE CHAFER, appeared in June, though in numbers conspicuously less than usual. On the college grounds the attack of this insect was most severe upon the young hydrangea shrubs, the leaves of which were eagerly devoured by the beetles, leaving only a framework of veins. (Fig. 15.) A number of substances were applied to check the injuries of the pests, but nothing was found so simple and effective as that of brushing them into a pail or pan holding a little water, on the surface of which is a little kerosene. This is to be done in the cooler part of the day when the beetles are more sluggish than in the warmer hours.

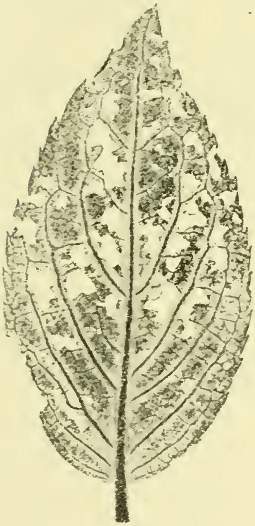

Fig. 15.— Leaf of Hydrangea eaten by Rose Beetles.

Several inquiries have been received during the year regarding a safe and effective remedy for the CABBAGE WORM (*Pieris rapæ*), which the present season has been at least as destructive as usual. In some parts of the country the practice of applying Paris green or other arsenical poisons to young cabbages has apparently been on the increase, the method having received the endorsement of a number of entomologists. It has been argued that there is no danger to the consumer because the amount of poison applied is so small, and as it is to be put on only when the plants are young before they have begun to head, the leaves to which it is applied will not be eaten. There is little doubt that the argument is sound, were it certain that the poison would only be applied under the conditions recommended. But the work must so often fall into the hands of ignorant and unskilled laborers, that the element of danger cannot be ignored. The first positive evidence of the danger that I have seen came to me in a letter from a correspondent at Hill, New Hampshire, who reported that he had known a case in which the members of a family had been made ill by eating cabbages which had been treated with Paris green.

We tried a large number of experiments with pyrethrum or insect powder as a remedy for the cabbage worm. This is one of the most important of the non-poisonous insecticides, killing caterpillars and other insects by merely coming in contact with their bodies. It was found to be effective when applied dry by means of a bellows, either undiluted, or thoroughly mixed with an equal quantity of flour. It also kills the worm when applied as a decoction made by adding one ounce of pyrethrum to one gallon of boiling water. Much less pyrethrum was required for a given area when it was put on in this way, than when it was used as a dry powder. The decoction is to be applied as a spray, either by means of an atomizing bellows, or a pump and spray nozzle. We also found that a one per cent solution of the Rose Leaf insecticide, a tobacco extract made by the Louisville Tobacco Company effectually kills the worms at a small expense.

The various stages in the life history of this cabbage worm are illustrated in Plate II. The adult insect is the common white butterfly, the male of which is shown at *c*, and the female at *d* of the plate. The latter deposits, singly, or in clusters of two or three each, small yellow eggs upon the cabbage leaves; these soon hatch into little green larvæ that feed upon the substance of the foliage. In about two weeks they become full grown, when they generally leave the cabbage plants, and finding some suitable shelter—beneath a board or under a coping of a fence,—change to chrysalids. They remain in this condition about ten days, when they emerge as butterflies, to lay eggs for another brood of worms. The winter is passed in the chrysalis state. There are several

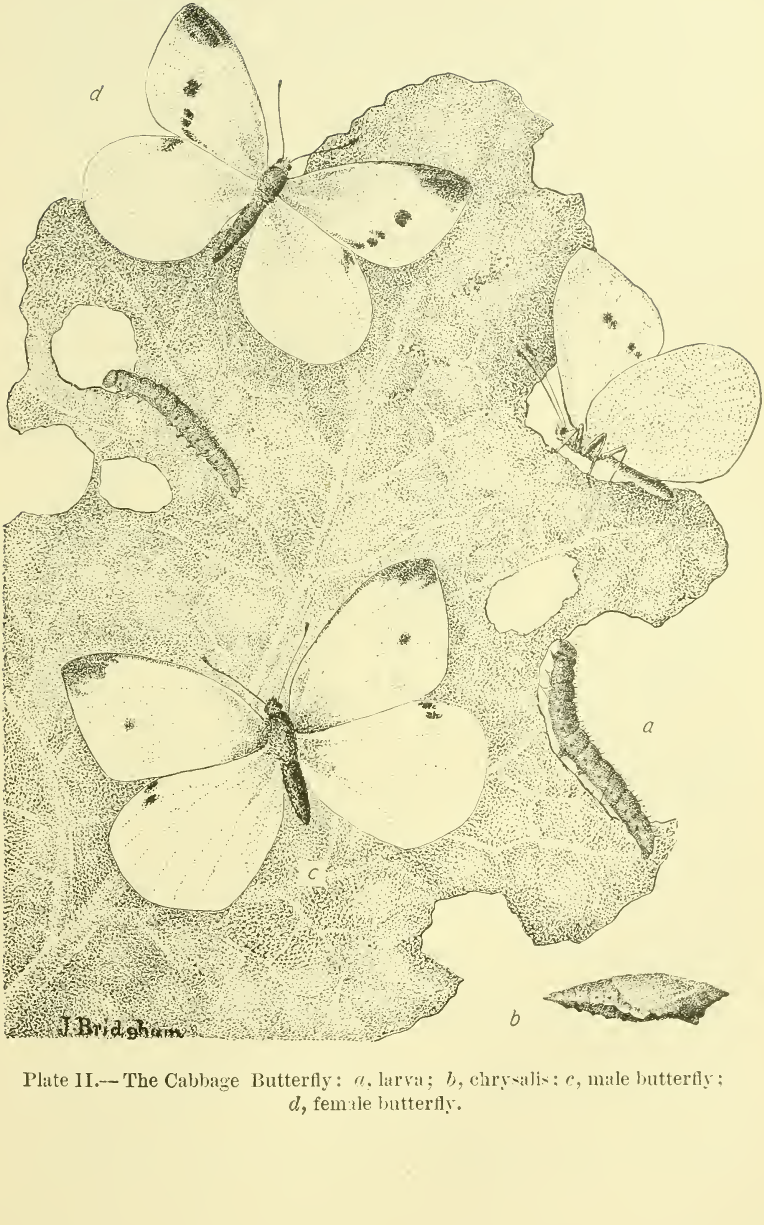

Plate II.—The Cabbage Butterfly: *a*, larva; *b*, chrysalis; *c*, male butterfly; *d*, female butterfly.

generations of larvæ each season, the number varying with the season and latitude.

During the spring numerous complaints were received regarding the injuries of the BEAN-WEEVIL (*Bruchus obtectus*), which appear to have been unusually severe. The presence of this insect is indicated by the small excavations which the larvæ make in the beans similar to those shown in Fig. 16 *c*. The fully developed weevil considerably magnified is represented at *b* of the same figure, its natural size being indicated at *a*. In the field these weevils deposit eggs inside the green pods in small clusters. In a short time the eggs hatch into tiny grubs that feed within the beans, maturing in about a month. These insects are also able to develop in dried beans, so that when they are present in beans put away in autumn, many more may be present the following season. The best way of preventing such a continuance of their injury seems to be to inclose the infested beans in a tight vessel in which a little bisulphide of carbon, benzine, or gasoline has been placed. The fumes of these volatile substances will destroy the beetles. Of course care must be taken that no fire comes in the vicinity of the treatment.

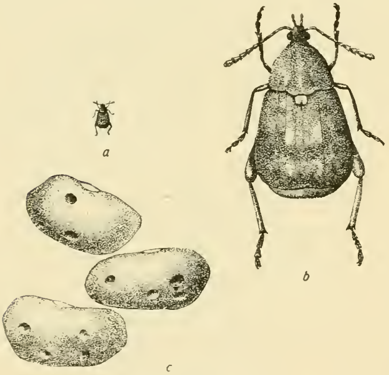

Fig. 16.—The Bean-Weevil: *a*, natural size; *b*, enlarged; *c*, beans from which beetle has escaped.

In the bulletin on the Canker Worm (No. 44) attention was called to the value of a substance called Raupenleim as a substitute for printer's ink in banding orchard trees. Letters received during the present year have shown that this substitute has been used with a great saving of the expense involved in the use of ink. The Raupenleim has been used in large quantities by the Gypsy Moth committee in Massachusetts. During a recent conversation with these officials I learned that there is sometimes danger in applying this substance to young and smooth barked trees, from the material penetrating the inner bark and killing the growing cells. Consequently I would recommend, in the case of young trees as well as those older which have a smooth bark that if Raupenleim be applied it be placed on strips of thick paper tacked to the trees. Even in the case of bearing apple trees this would probably be the safer method, and it should always be adopted for peach trees, if not for pear trees also. After the Raupenleim has been on some weeks the surface hardens into a crust, and it is advisable to scrape off this crust after the danger from canker worms is past. Too much of the rough bark should not be scraped off of the older trees to which the band of Raupenleim is to be applied, unless paper is to be used.

Less than the usual amount of injury was done this season by the apple worm, the larva of the CODLING MOTH (*Carpocapsa pomonella*). This immunity was probably due in part at least to the small apple crop of the last year. There has also been but little complaint regarding the APPLE MAGGOT (*Trypeta pomonella*), or Railroad Worm. The SQUASH BUG (*Anasa tristis*), STRIPED CUCUMBER BEETLE (*Diabrotica vittata*), and various flea beetles have been about as destructive as usual, while the SUGAR MAPLE BORER (*Glycobius speciosus*), treated of in Bulletin No. 33 of this station, is continuing its destructive work in many parts of the state. Little injury, however, has been done by the WHITE MARKED TUSSOCK MOTH (*Orgyia leucostigma*) discussed in the same bulletin. The PEAR SLUG (*Eriocampoides limacina*) was somewhat destructive in the southern part of the state. The HORN FLY (*Haematobia serrata*), or Texas fly, has been reported as very troublesome at Franklin Falls.

CLARENCE M. WEED,
Entomologist.

DEPARTMENT OF METEOROLOGY AND AGRICULTURAL ENGINEERING.

1897-'98.

I. METEOROLOGY.

Observations have been continued the past year as heretofore under the charge of James A. Foord, New Hampshire College, class of '98, who has been assisted for a portion of the year by William F. Fiske, special student in biology.

Signal flags have been displayed each day, except Sundays, throughout the year from the tower of the experiment station building, indicative of the weather for the succeeding night and day. In addition, a synopsis of weather conditions has been written each day upon the blackboard at the station building for the benefit of the station workers.

Another year has been characterized by a large precipitation, and it is like the last in having this precipitation quite uniformly distributed throughout the year. There has been no suspicion of drought, and the soil has been moist continuously. The least number of rainy days in any month was five, the same as for the year preceding. The total rainfall was seven inches less than for the previous year, chiefly because of the absence of such remarkable storms as those of September 6, 1896, and June 10, 1897. The mean temperature of the summer months of 1897 was about normal, but there was a notable lack of extremes. Only one hot spell occurred in July, not one in August, and one in September. No one was of great length or of excessive severity. July was the wettest month of the year, judged by its total rainfall. In both July and August the weather was very catchy, so that it was almost impossible to cure hay seasonably or well. It was frequently remarked that nothing like it was remembered by the oldest inhabitant. The result was a large crop of very poor quality of hay. Other crops were backward, but the long season helped them out so that a fair harvest was reaped. No killing frost occurred till near the close of September.

October averaged warm, owing chiefly to warm days indicated by an unusually high mean maximum. It was the dryest month of the year, with only one half inch of rainfall and five rainy days.

November has some claim to be considered the wettest month as it stands first in number of rainy days, and second in total precipitation. It was as much colder than the average as October was warmer, contrary to expectations based on difference in rainfall. The last week was unusually cold for the season.

December temperature was medium warm. No snow of any amount came to stay till the last day of the month. Upon the sixteenth all frost came out of the ground, and the unseasonable spectacle was presented of numerous people plowing upon December 17.

January was a normal month in all respects. Three cold spells were noted, but they were all, with possibly one exception, of a mild order. Sleighing was continuous through this as well as the following month.

February came in with a driving snowstorm, that came near being a record breaker. Not even an engine passed this railroad station for twenty-four hours, and on the second day trains were one to three hours late. It was more the fury of the wind than the amount of snow that caused the total stoppage of traffic. The precipitation and temperature for the month were medium. Only one sustained cold spell occurred and this was not excessive.

March was unseasonably warm with a small precipitation, while opposite conditions prevailed in April, thus showing a second time in one year unexpected monthly combinations of high temperature with small precipitation and the reverse.

May was a wet month with fourteen rainy days. The old saying, "A wet May for hay," proved a true prophecy.

The precipitation for June was also abundant though not excessive, and the making of a large hay crop was thus assured. Other crops were backward on account of the wet spring, but on the whole made a good growth.

A summary of the observations taken will be found appended.

II. AGRICULTURAL ENGINEERING.

Progress has been made during the year in extending the bounds along the highway in front of college property. Stone posts have been set and located where necessary between the corner of the President's lot, next to Professor Rane's house, and the Louisa Smith lot on Main street; also, upon Madbury street as far as the Silas Jenkins lot, except that the location of the north line of the dormitory lot next to the Louisa Smith lot has not yet been fully adjusted.

The steam drill belonging to the college was employed late in the fall of 1897 to complete the excavation of stone in the field west of the railroad station. The stone, however, were not moved away till spring, a derrick being then set up to assist in the work.

Experiments in road surfacing of quite extensive character were carried on during the spring of 1898, the details and results of which will appear in due time in bulletin form.

Class instruction was carried on in connection with the use of the steam drill, the derrick, and different materials

Road conventions at Keene, N. H., and Vergennes, Vt., have been attended during the year, and numerous talks upon road construction given at other places.

C. H. PETTEE,
Meteorologist.

METEOROLOGICAL SUMMARY.

	Average temperature.		Precipitation.*		Snow in inches.		No. days .01 inch precipitation.		1897–1898.			
	1896–1897.	1897–1898.	1896–1897.	1897–1898.	1896–1897.	1897–1898.	1896–1897.	1897–1898.	Prevailing wind; direction.	Days clear.	Days partly cloudy.	Days cloudy.
July	70	69	2.85	6.98	....	....	11	9	E.	9	9	13
August	67	66	3.68	2.99	....	....	9	10	W.	15	12	4
September	58	59	9.48	2.71	....	....	11	8	W.	15	5	10
October	46	49	2.50	.49	....	....	13	5	W.	15	10	6
November	40	36	3.47	6.79	1.7	5.5	8	16	N. W.	10	6	14
December	24	27	1.76	5.33	3.5	14.2	5	10	N. W.	10	3	18
January	23	21	4.84	3.59	17.7	32.0	9	7	N. W.	14	6	11
February	25	26	2.31	3.03	13.5	17.0	5	8	N. E.	9	6	13
March	32	37	4.40	1.56	12.0	8.5	10	7	W.	17	6	8
April	46	41	2.50	5.39	....	7.0	11	13	N. W.	12	6	12
May	55	55	4.94	3.79	....	....	10	14	S. E.	12	9	10
June	60	65	8.85	2.14	....	....	11	12	S. E.	11	12	7
Sum	546	551	51.6	44.8	48.4	84.2	113	119	W.,N.W.	149	90	126
Mean	45.5	45.9										

* Including rain, hail, sleet, and melted snow in inches.